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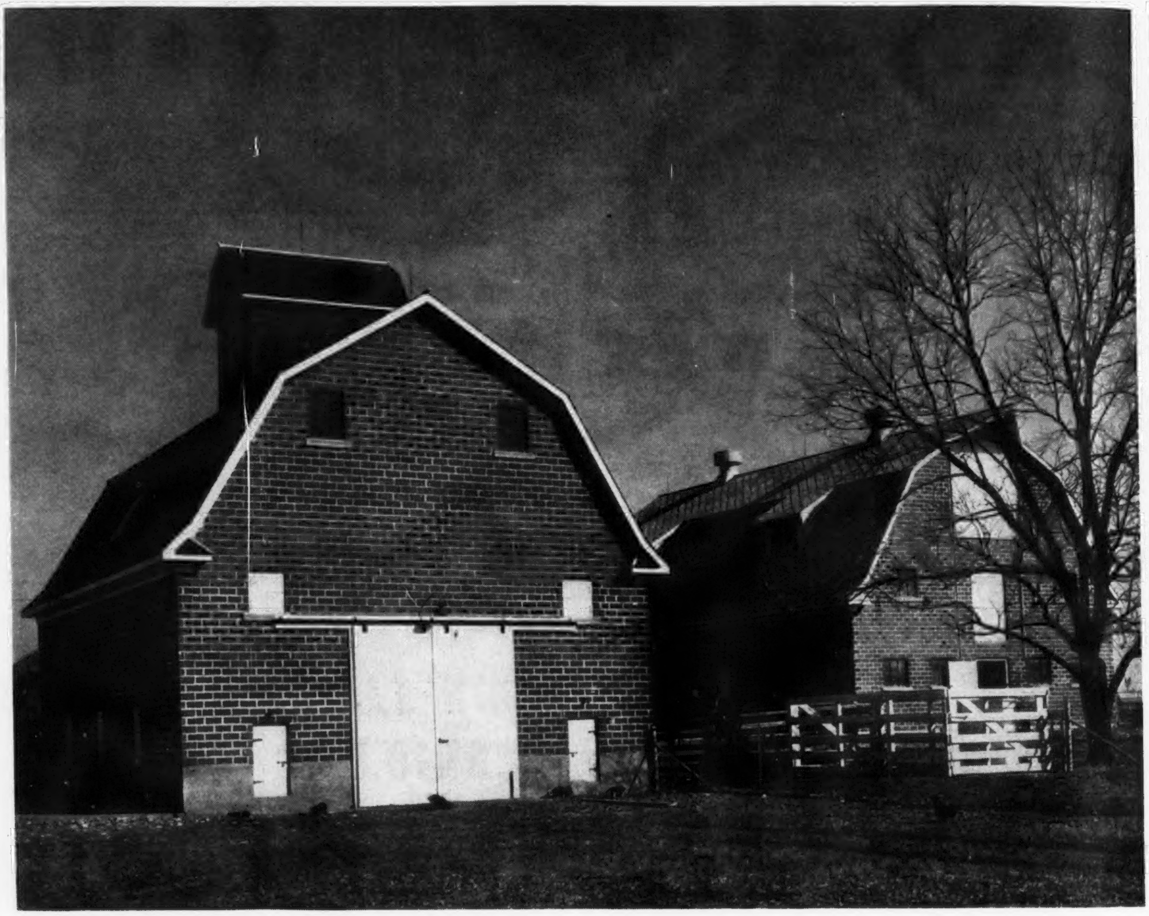


Engineered Design for Controlled Farm Operation

THIS corn crib and granary (left) and general-purpose barn (right) are constructed principally of structural clay tile and are a part of the production equipment on the 400-acre livestock farm of J. E. Decker, near Mason City, Iowa. The former will hold 4,000 bushels of ear corn and 8,000 bushels of small grains.

Substantial, large-capacity cribs and granaries are becoming increasingly important in grain and livestock farming areas, for protection of grain until it can be profitably marketed, or processed into animals and animal products. The farm granary minimizes the extent to which grain must be dumped on the market as soon as harvested, saves long hauls at harvest time, and enables the farmer to choose the time and extent to which he will sell cash grain or feed livestock, according to the opportunity for profit offered in relative prices. It also improves his basis for intelligent planning of his operations for the following year. Agricultural engineering provides design for structural requirements, and for use economy in the production program of the individual farm.

To be a profitable investment a farm granary should be structurally sound and durable, be weather and vermin proof, permit circulation of air for further drying of stored grains, permit easy filling and easy removal of grain, represent a low investment per bushel of capacity, and be used to capacity in the farming program.

AGRICULTURAL ENGINEERING

VOL 19, NO 4 EDITORIALS APRIL 1938

"Go West"

THE West offers a wider variety of agricultural and agricultural engineering problems, and of innovations in their solution, than any comparable area of the United States.

More special types of farm equipment are manufactured and used there than in probably the whole area east of the Rockies. Crops grown elsewhere are often grown and handled differently there. Many crops are grown there which are not widely grown elsewhere. Farming is done on a wider range of extensive and intensive operation, in a wider spread of climatic and soil conditions. Operating organization varies from rugged individualism to widespread community cooperation. There is a wide assortment of examples of plots of ground with unique agricultural possibilities being subject to special engineered control for specialized production, to make the most of production and market opportunities.

These characteristic features of western agriculture and agricultural engineering problems will be featured in the program of this year's annual meeting of the American Society of Agricultural Engineers at Asilomar. They are offered as attractions to agricultural engineers of the Midwest, South, and East, but not with any idea that western methods present ready-made solutions to agricultural engineering problems in the more prosaic grain, livestock, cotton, and general farming areas east of the Rockies. What they do offer is inspiration and opportunity to grow in appreciation of the possible variety and extent of engineering approaches to the production and operating problems of agriculture. They offer, not ready-made solutions to farm operating and operating equipment problems of the whole country, but practical, proven object lessons in creative originality applied to agricultural engineering jobs under quite definitely specified conditions and limitations.

Let's "Go West" to the annual meeting not to see how westerners would solve our problems, but to see what they do about theirs, and to gain inspiration and appreciation of our own capacity to do more about meeting and mastering agricultural engineering opportunities in our own states and individual jobs.

The Agricultural Surplus

AGRICULTURAL engineering has been a factor in the United States production of an agricultural surplus to an extent which warrants consideration of that surplus, in the interest of possible improvement in understanding and action favorable to farm and general prosperity.

Mr. F. A. Wirt (a member and past-president of A.S.A.E.) has been studying this situation over a period of several years, and has compiled a large fund of most interesting and valuable information. His data and analysis, on which the following paragraphs are a brief comment, provide a good basis for discussion.

From the time they were successfully established, the North American colonies, and later the United States and its territories, have continuously produced a surplus of agricultural crops over requirements for home consumption. In addition to improvements in farming methods and equipment, contributing factors have been our rich resources of farm land, foreign capital, foreign markets, comparatively free trade, development of water and rail transportation, immigration, the Homestead Law, and wars.

And from the time the colonies were first established, trade has brought prosperity, while periodic restrictions to trade have resulted in depression.

Until about 1917, foreign investments in this country made it a debtor nation, and our agricultural surplus largely paid our interest due the people of other nations. Since the World War, and particularly since 1930, our growing tariffs against imports have seen reciprocal tariffs and quota laws raised against our exports in a wave of economic nationalism. Agricultural production capacity does not contract as easily as it expands. The result of this combination of circumstances has been a large domestic surplus of farm crops, greatly reduced foreign markets, low prices for farm products, and agricultural depression. Reduced farm buying power has apparently been a large factor in the coincidental general depression.

We cannot correct the mistakes of the past, but by keeping principles in mind, further repetition of these mistakes might be avoided.

It is elementary economics that mutual benefit to the buyer and the seller is the basis of trade. Restrictions to honest trade are restrictions to benefits. The United States government prosecutes private combinations in restraint of trade within its boundaries; it maintains an Interstate Commerce Commission to protect and facilitate sound trade between its states; and at the same time it is acting as a combination in restraint of trade between its people and those of other world states. In view of developments it seems desirable to reconsider the extent to which economic autonomy is desirable for the people of the United States, to reweigh the benefits for which we are sacrificing the benefits of our former foreign trade, including our foreign market for agricultural surpluses and our farm buying power for domestic products.

It is also elementary that money is a comparatively small element of total wealth; that its principal value is as a basis of exchange of other values, and that we therefore cannot trade only for money, but must accept other values in the form of goods and services in return. There is no reasonable hope of encouraging export trade while discouraging imports. The question this country faces is whether or not it wants any foreign trade, and if so, how much and of what nature.

As a creditor nation with surplus capital, labor, manufacturing capacity, transportation, and farm production capacity all looking for profitable employment, the things we can import most profitably are raw materials of which our own supplies are low or inadequate. These include many of the rarer metals and other natural mineral and organic chemicals found or produced more abundantly and at lower cost beyond our borders. They can provide employment for our productive facilities, and markets for

finished products, including agricultural surpluses, with minimum dislocation and disadvantage to any particular sections or classes of our population. At the same time, our own exhaustible supplies can be conserved. Processing and manufacturing raw materials from more pioneering nations and selling them finished products is a natural economic opportunity for us as a creditor nation. Incidentally this trade would create a greater buying power for our agricultural surplus, not only abroad, but among our own laborers as well, and a greater buying power among our farmers for our manufactured products. It would seem in the public interest to have these raw materials on the free or low-tariff list of imports.

There is substantial evidence that those of our industries which have operated without benefit of protective tariff, have experienced the greater benefit of competitive stimulation to higher efficiency in management, production, and customer satisfaction. Intelligent well-paid labor and engineered production equipment have repeatedly beaten low-wage hand labor in the game of low-cost production. It seems doubtful if any industry in the United States should have to ask odds over foreign competitors in our domestic market. If some protection is necessary, why not protect ourselves as consumers and put our domestic market competition on a quality basis by requiring imports to meet acceptable quality-value standards? Protective tariffs may be easier to get than high efficiency, but they are less dependable insurance of a domestic market and positively destructive to our foreign markets.

Production restrictions cannot solve the surplus crop problem because farmers are not one economic class, but a large number of classes competing among themselves in this and other countries. Production restrictions here invite increased foreign competition in world markets. Production restrictions on certain crops mean increased production and competition in other crops, together with higher prices to farmers who are consumers of the restricted crops.

There are some good reasons why our agriculture should continue to produce a surplus over our nation's food and fiber requirements. It is protection against shortage due to crop failures and other emergencies, with resulting high food prices, and privation to laboring people. It keeps a safe reservoir of the virile farm population with which our cities need to be continually revitalized. It stimulates development of industrial uses for our farm products, which will contribute to a more sound national economic independence than will protective tariffs, with less privation in the process. It stimulates farmers to lower their costs of production, thereby increasing their net return, the real wages of laborers, who benefit by lower food prices, and the buying power of both. That should interest manufacturers.

Throughout the history of our nation the improvement, production, sale, and use of farm equipment has resulted in increasing farm production efficiency, and thereby has been an important factor in creating our agricultural surplus. The farm equipment industry has grown, without benefit of protective tariff, into one of our major industries, furnishing employment and buying power to a substantial proportion of our domestic consumers. Its future hangs on the market for agricultural surpluses.

If agricultural surpluses and foreign trade are desirable as indicated, the farm equipment industry is none too big for the legitimate economic service it can render. It has a future along the lines of its present development. Current artificial restrictions to foreign trade could be removed by understanding and popular demand.

If agricultural surpluses are desirable, but not foreign trade, the hopes of our farm equipment industry are limited to a domestic market with little opportunity for expansion. The National Farm Chemurgic Council is making commendable progress in developing and encouraging the industrial use of farm products which offers the only market, other than foreign trade, for farm product surpluses. But that is a long-time project. It will be several years at least before our industries are prepared to utilize even the current volume of agricultural surpluses. What would happen to farm buying power during those years?

If neither agricultural surpluses nor foreign trade are desirable, the hopes of our farm equipment industry as such are limited to a reduced domestic repair and replacement market. It is really not a hope, but a life sentence to confinement and atrophy within one small economic cell.

Agricultural engineering, as a professional factor in the production of agricultural surpluses, and all of the other arts and sciences of modern agriculture, likewise hang on the desirability of agricultural surpluses and of foreign trade. In fact, are these not the heart and soul of our nation's opportunity for economic service, for the production and distribution of wealth, and for social progress?

We believe this is a fair brief presentation of the case for low tariff and a foreign market for our surplus farm crops. If any reader sees and wishes to present a case for high tariff in the interest of agricultural and general prosperity, we will be pleased to receive his comments. We are interested not in any special group advantage from either low or high tariff, but in the true economic relationships involved, their understanding, and their application in the interest of general prosperity.

Effective Extension Cooperation

OUR attention has been called to the manner in which extension entomologists cooperate with other agencies in spreading information on insect control. The information is given in a paper by T. H. Parks of Ohio State University, presented before the last meeting of the American Association for the Advancement of Science. Perhaps agricultural engineers could gain a suggestion or two from the practices followed.

The extension entomologist in state service is said to evaluate the most urgent needs within his state and formulate a yearly program of organized insect control based on voluntary action. Then he reaches as many as possible of the agencies contacting farmers, and interests these agencies in passing along information on the approved control methods. The agencies include insecticide, fertilizer, and spray machinery manufacturers, floral supply houses, farm bureau service companies, wholesale and retail seed and insecticide dealers, local banks, local canning companies, grain elevators, commercial spray operators, exterminating operators, railroads, and insecticide salesmen, in addition to the usual extension publications, meetings, newspaper publicity, and radio.

The effectiveness of the extension procedure seems due to the thoroughness with which the entomologists sell these commercial interests on the value to them of passing on the state approved practices. It seems possible that such organizations as banks, canning companies, and various dealers could also be convinced of a possible self-interest in passing on to farmers more information on proven and approved principles and practices in organizing, equipping, and operating farms for low-cost production.

Farm Tractor Fuel Trends

By C. E. Frudden

TRACTOR fuel choice seems in most cases to be a matter of conclusions formed without much consideration of underlying facts. Perhaps sales influence has pushed clear thinking to one side. This paper is an attempt to analyze the tractor fuel situation in the light of some generally accepted engineering facts regarding engine performance. From these accepted facts, the conclusions to be drawn become obvious.

For the purpose of this discussion, tractor fuels will be classified as follows:

1 *Tractor Distillate* suitable for operation in carburetor type engines. These fuels have an end point of less than 600 F (degrees Fahrenheit) and an octane number generally less than 35.

2 *Gasoline,* often referred to as *third grade,* having an octane number of 50 to 60.

3 *Gasoline,* often referred to as *regular,* having an octane number of 68 to 70.

In order to confine the discussion to common and typical cases in which the greatest number of farmers may be concerned, a two-plow, general-purpose tractor will be considered. The engine is one of about 200 cu in displacement, developing approximately 25 hp. The typical engine is considered to be of four cylinders with overhead valves, and intake manifolds, as well as compression pressures made variable to best suit the operating conditions required by each of the three kinds of fuels mentioned. It is assumed that the engineering involved in the products of the various competing manufacturers is of the same high order in all cases, and, accordingly that any difference in performance records of the engines made by different manufacturers is due to differences in one or more of the factors to be discussed in this paper.

The power developed by an engine and its fuel consumption depend primarily upon two design factors, as follows:

1 Compression Ratio. The higher the compression pressure (or ratio), the greater the power and the less fuel consumption per horsepower-hour.

2 Intake Manifold Temperature. The colder the manifold, still maintaining good overall performance, the greater the power.

The highest practical compression pressure (or ratio) is limited primarily by the octane number of the fuel used. The higher the octane number, which is the measure of the knocking tendency, of the fuel to be used, the higher it is possible to raise the compression pressure in designing the engine. Other factors also control the maximum permissible compression pressures, but it is assumed that all these factors are thoroughly understood by the engine designers, and there is not much difference between tractor engines in these respects. These factors mentioned for reference only are (1) diameter of pistons, (2) cooling efficiency, particularly of the hottest parts of the engine, (3) combustion chamber design, (4) manifold temperatures, (5) cooling water temperatures, and (6) air-fuel ratio.

Intake manifold temperatures must be high enough to properly prepare and distribute the air-fuel mixture. The higher the boiling range of the fuel, the higher the manifold temperature required. The efficient method of heating intake manifolds is understood by all tractor engine designers, and accordingly all tractor engines are very similarly designed in this respect.

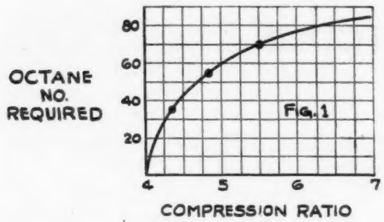
Referring to Fig. 1, it is to be observed that a compression ratio of about 4 to 1 is the highest practical ratio that can be used in the engine when burning zero octane fuel, without experiencing serious "knocking." If fuels of 35, 55, or 70 octane are to be used as the basis for the engine design, compression ratios of 4.3, 4.8, or 5.5 may be adopted with no greater tendency toward detonation than when using zero octane fuel in an engine of 4 to 1 compression ratio. These figures are not specific for any one engine, but represent quite accurately what may be expected in a general way in all tractor engines of the type and size under consideration.

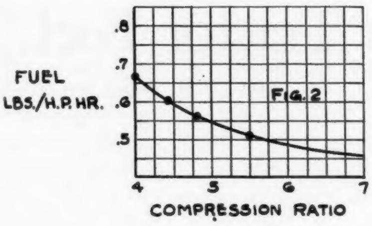
Fig. 2 shows in a general way how the fuel consumption, in pounds per horsepower-hour, decreases as the compression ratio is increased. The specific consumption at 4 to 1 is about 0.66 lb per hp-hr, whereas at 5.5 to 1, it is only about 0.52. The fuel saving is about 20 per cent

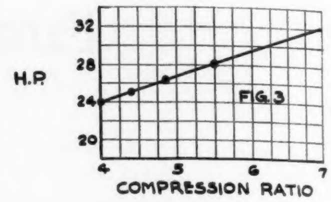
Presented before the Power and Machinery Division at the fall meeting of the American Society of Agricultural Engineers, at Chicago, Ill., November 30, 1937.

Author: Chief engineer, tractor division, Allis-Chalmers Mfg. Co. Mem. ASAE.

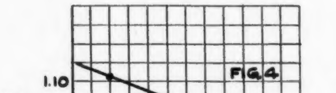
"THE TREND IN FARM TRACTOR FUELS WILL BE DETERMINED BY THE PURCHASERS OF TRACTORS, AND THE TAX SITUATION IS A BIG FACTOR IN DETERMINING THE TREND"







between these two extremes. (It should be noted that as between tractor distillate and gasoline, there is a difference of about 10 per cent in the weight per gallon, and accordingly the possible saving between the two extremes on a gallon basis is about 10 per cent.)



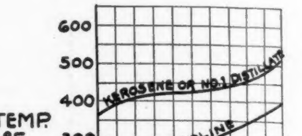


Fig. 3 indicates that the horsepower of the engine may be increased from 24 to 29 by increasing the compression ratio from 4 to 1 up to 5.5 to 1.

Fig. 4 shows the effect of intake manifold temperature on the horsepower of the engine. To burn tractor distillate in a satisfactory manner, a manifold temperature on the order of 200 F is necessary, whereas when burning gasoline, a temperature of 125 F is sufficient for good operation. The 75-deg difference in temperature means a difference of about 12 per cent in power. It is to be noted that on account of this loss in power, there is often a tendency to run manifold temperatures too low for best all-round results when burning tractor distillates.

Fig. 5 is shown as an explanation for the necessity for higher intake manifold temperatures when burning tractor distillate.

Accepting as facts the relative values of the above variables, it is quite possible to accurately estimate operating costs so far as fuel and lubricating oil is concerned, and draw conclusions accordingly. A tractor on which accurate records were kept for one year is used as a fair example. It operated 700 hr and burned 910 gal of gasoline, when built with a compression ratio of 4.3 to 1. The cost of fuel and oil for the year's operation is shown in the accompanying table using the actual results as a base, and calculating the costs under other operating conditions from the data submitted. It is assumed that for equally good lubrication, twice as much lubricating oil is used when burning tractor distillate as when burning gasoline. The costs of fuel per gallon are taken as rough averages prevailing in the corn belt, but they can be corrected to correspond with locally prevailing prices for making more exact comparisons for any given locality.

Aside from the item of operating costs, which will vary with costs per gallon and particularly with the amount of tax that is added to the cost of fuel, there is a big intangible factor, which for a better term will be called "operatthe convenience". It is more convenient to burn gasoline than tractor distillate, and if there were no cost differential, it is not likely that any farmer would choose to burn distillate. No doubt the degree of the spread in costs will determine the choice in most cases. In Nebraska and Louisiana, where the spread is great because of the tax, the choice of fuels may not be the same as in Iowa or Illinois, where the tax is refunded. In Italy, where it is reported that gasoline sells for 60 cents per gallon, it is unlikely that much of it will get into tractor fuel tanks. *(Continued on page 157)*

Power and Economy Possibilities
200-cu in Engine at 1300 rmp
in a Two-plow Tractor

A — 0 OCTANE KEROSENE 4 to 1 COMPRESSION 200 deg MANIFOLD	24 hp .66 lb hp-hr
B — 35 OCTANE DISTILLATE 4.3 to 1 COMPRESSION 200-deg MANIFOLD	25 hp .6 lb hp-hr
C — 55 OCTANE GASOLINE 4.3 to 1 COMPRESSION 125-deg MANIFOLD	23 hp .6 lb hp-hr
D — 55 OCTANE GASOLINE 4.8 to 1 COMPRESSION 125-deg MANIFOLD	29 hp .56 lb hp-hr
E — 70 OCTANE GASOLINE 5.5 to 1 COMPRESSION 125-deg MANIFOLD	31 hp .52 lb hp-hr

Probable Cost of Fuel and Oil per Year
(700 Hours)

			Fuel and oil	Gas tax, at 5c	Fuel, oil and tax
840 gal kerosene	at 8c	$ 67.20			
60 gal gasoline	at 12c	7.20			
40 gal oil	at 50c	20.00			
			$ 94.40	$ 3.00	$ 97.40
760 gal distillate	at 8c	60.80			
60 gal gasoline	at 12c	7.20			
40 gal oil	at 50c	20.00			
			88.00	3.00	91.00
910 gal gasoline	at 12c	109.20			
20 gal oil	at 50c	10.00			
			119.20	45.50	164.70
855 gal gasoline	at 12c	102.60			
20 gal oil	at 50c	10.00			
			112.60	42.75	155.35
790 gal gasoline	at 13c	102.70			
20 gal oil	at 50c	10.00			
			112.70	39.50	152.20

Power, Fuel, and Time Requirements of Contour Farming

By E. L. Barger

CONTOUR tillage of land is an old practice in many parts of the world. In fact, it has been used to a limited extent in different parts of this country for over a hundred years. This type of cultivation, however, has never appealed to the corn belt farmer of the United States. Not until the U. S. Soil Conservation Service made this method a definite part of its program for soil and moisture conservation had the farmers of this farming region thoroughly considered or seriously attempted contour farming their land as a regular practice. Many reasons have been set forth to justify recommendations for extending the practice of contour farming. Foremost, of course, has been the conservation of soil and moisture through the running of furrows and rows across the slope. Furthermore, it is a necessary procedure when strip cropping is practiced. With the widespread use of terraces, the carrying out of the tillage and field operations on the contour aids greatly in maintaining the terrace structure.

A secondary consideration that has been in the minds of many and one that should have some influence in encouraging a wider use of the contour system of farming is the possible advantage in the saving of power, fuel, and time. Data regarding this advantage have been lacking.

During July and August 1937, tests were made at Manhattan and Hays, Kansas, to obtain comparative data on contour and uphill and downhill farming practices. This work was done cooperatively by the Kansas Agricultural Experiment Station, the Kansas Engineering Experiment Station, and the research division of the U. S. Soil Conservation Service.

The objectives of the tests were to measure (1) draft and horsepower requirements of several farm implements on contour and uphill and downhill plots, (2) fuel consumption per unit area of field work done under the two conditions, (3) time per unit area required to perform various operations, and (4) the effect of uphill operation as a limiting factor in tractor operating efficiency. No attempts were made to measure the number or effect of turns. All measurements were confined to small, carefully measured areas on rather uniform slopes. All turns were made outside the test area.

Two types of plot layout were used in attempting to eliminate soil differences. Fig. 1 shows the general layout of uphill, downhill, and contour plots which were used in nine of the ten test areas. After selecting a field with suitable characteristics, a line was run parallel to the slope with a transit, and elevations were taken. Plot end lines were run at 90-deg angles to this line, and 300 ft apart. These were placed in far enough from fences or field boundaries to give ample room for starting and adjusting equipment before reaching the plot boundary. Three contour lines were run (except plot 5 in which two were used) as close to the side of the uphill and downhill plot as possible. They were located near the top, middle, and bottom of the slope. Plot 2 served as a contour plot to go with plots 1 and 3. This arrangement proved to be satisfactory, but it was not possible to combine three areas in this manner in any of the other fields. After the plots were staked out, backfurrows were plowed and a single, shallow furrow was made at the end lines. Six rounds with plows made on the uphill and downhill, and two rounds on each of the contour plots, constituted a test. A fewer number of rounds was made with some of the wider implements, but in all cases the area worked was equal to or larger than the plowing tests. Test areas varied between 0.212 and 0.510 acre, and averaged 0.357 acre.

The second type of field layout is illustrated in Fig. 2. It was felt that this type of plot might have some advantage with such implements as harrows and disks, with which it would not be difficult to cross ground already worked. The effect of crossing the worked ground should influence the uphill and downhill and contour work equally. A wheatland disk plow, frequently referred to as a one-way disk, was used in this plot. The procedure was to make one round downhill and uphill, then drive around the corner and make a round on the contour. Five rounds on each constituted a test. Objections to the plan were that checks

Presented before a joint session of the Soil and Water Conservation and Power and Machinery Divisions at the fall meeting of the American Society of Agricultural Engineers at Chicago, Ill., December 2, 1937. Contribution No. 85 from the department of agricultural engineering, Kansas State College.

Author: Assistant professor of agricultural engineering, Kansas State College. Mem. ASAE.

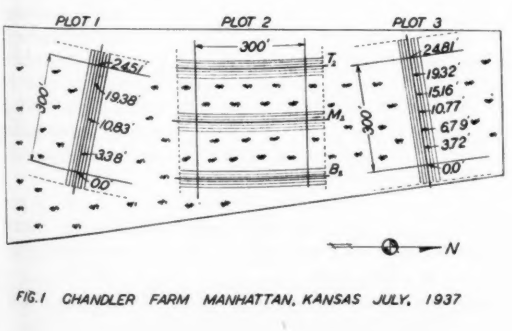


FIG. 1 CHANDLER FARM MANHATTAN, KANSAS JULY, 1937

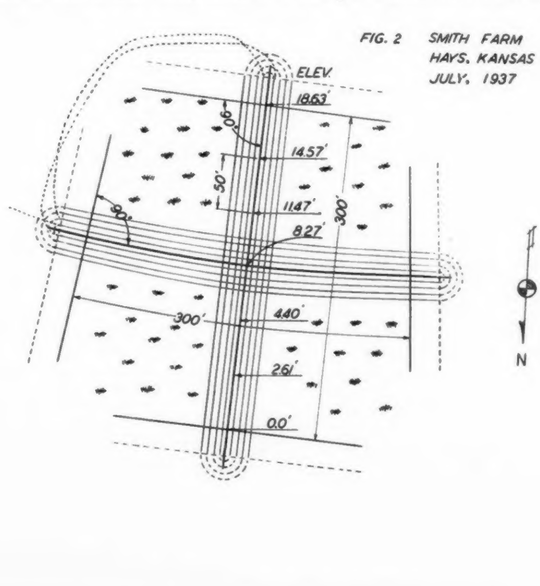


FIG. 2 SMITH FARM HAYS, KANSAS JULY, 1937

by subsequent fuel tests were difficult to make, because in each succeeding case a greater proportion of worked soil was covered, and the drive around the corner was time consuming and somewhat unsatisfactory with an implement as unwieldy as a disk plow. Plots 1, 2, and 3 were near Manhattan on a rather heavy clay loam soil. Plots 4 to 10, inclusive, were near Hays. The soil on which these plots were located was very dry and ashy, containing some limestone gravel near the tops of the plots and running into a loamy, alluvial deposit near the bottoms of the slopes.

Implements used in the tests included a two-bottom plow, three-bottom plow, tandem disk harrow, duckfoot field cultivator, wheatland disk plow, and damming lister. Five tractors were used, three of them in drawing the implements and two in drawing the combined outfit of tractor and implement in draft tests.

Two auxiliary fuel tanks were mounted on the test tractors. The main tractor fuel tank and the auxiliary tanks were connected by three way valves with controls, conveniently located, so the operator could switch to any one while operating.

In making time and fuel tests the tractor driver turned the fuel switch to the test tank as the front wheel of the tractor passed over the end marker furrow. An assistant and note keeper started a stop watch at the same instant. At the other end of the field the reverse procedure was followed. After the required number of rounds the fuel tank was weighed in. Time for each trip across the plot was recorded. The width of test areas was measured and recorded, and depth measurements taken to check on possible depth variations between uphill and downhill and contour plots. In all tests, however, the depth adjustments on the implements remained the same.

The dynamometer used was of a hydraulic recording type built at the college. It is illustrated in Fig. 3. The load is traced on a chart which is driven at a rate proportional to ground travel. A planimeter is used to measure chart area and from this area draft is calculated. Length of test is taken from the chart. Time is measured with a stop watch operated automatically and started and stopped by the same hand switch operating the solenoid-actuated start and stop recording pencil.

Draft tests were usually run on the same day that fuel tests were made, and in no cases were ground conditions altered by rain between the time fuel tests and draft tests were made. Draft tests were made at several speeds, ranging from about one mile per hour up to a speed equal to or above the speed used in the fuel tests, whenever it was possible to do so. This gave data with which to plot curves of speed and draft, to use in determining the draft at fuel test speeds. Draft tests were made on the implements and also upon the combined unit of tractor and implement by pulling the combined unit through a cable by a larger tractor.

Table 1 gives the results of fuel and time tests on plots 1, 2, and 3 at Manhattan with a two-bottom plow. The figures in each line are averages of from two to four tests. Two conditions are shown here which are typical of the two farming practices. The first and third sets of comparative data show cases where the uphill travel was in one gear slower speed than the downhill travel. The second and fourth sets show all data taken in the same gear. In this case the tractor was definitely overloaded on the uphill travel, but since it is rather common practice for a tractor operator to refrain from shifting until he is forced to, we included the data. In other (later) tests it was frequently necessary to shift on the uphill travel. This is an important factor in the results, as can be seen. The tests in which second gear was used going uphill show 30.0 and 27.5 per cent greater plowing capacity on the contour and 11.8 and 7.9 per cent fuel savings. The tests where no shift of gears was made show only slight gains, 4.3 and 1.9 per cent, in capacity on the contour, and fuel savings of 9.4 and 5.5 per cent.

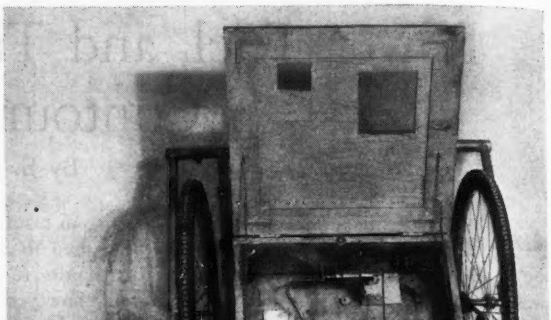


FIG. 3 HYDRAULIC RECORDING DYNAMOMETER USED IN DRAFT TESTS

Table 2 shows results of plowing tests with a three-bottom plow at Hays. On plot 4 it was necessary to shift on the upgrade. The time factor was in favor of the contour by 16.4 per cent and the fuel saving was 8.9 per cent. Plots 6 and 7 were plowed with the same equipment but all in a lower gear (second). The time saving for the contour was negligible, being 1.8 per cent, and the fuel saving was 3.0 per cent.

The results of plowing up and down a 6.21 per cent slope and on the contour with a wheatland disk plow are given in Table 3. The gear ratio difference between second and third gears is less in this tractor, and while the uphill travel was made in second, the acre-per-hour capacity was only 9.8 per cent greater for the contour test which was made in third gear. The fuel saving on the contour was 22.4 per cent and was the largest saving shown in any of the tests.

A 7-ft tandem disk harrow was used on plots 2 and 3, both on plowed ground and wheat stubble. Table 4 shows the results of these tests. The tractor had power enough to pull the disk in third gear on the contour and downhill, on the plowed ground, but it was necessary to run in second because the ground was rough. The time saving of 1.3 per cent on the contour was of about the same order as other tests where the same gear was used and the fuel saving was 3.5 per cent.

It was necessary when disking stubble on the 8.27 per cent slope to shift gears on the upgrade. The time factor was in favor of the contour plot by 28.8 per cent and fuel saving was 8.0 per cent.

Listing was done with a damming lister on plots 8 and

TABLE 1. PLOWING WHEAT STUBBLE WITH MOLDBOARD PLOW, MANHATTAN, KAN., JULY 1937

Equipment: John Deere A tractor on rubber tires and John Deere No. 52, two-bottom, 14-in plow on rubber tires.

	Plot No.	Gear Up	Gear Down	Slope, per cent	Average speed, mph	Acres per hour: Acres	Acres per hour: Per cent	Fuel consumption: Pounds per acre	Fuel consumption: Per cent
Up and down	1	2	3	8.17	4.23	1.30	100.0	11.50	100.0
Contour	2	3		0	5.15	1.69	130.0	10.14	88.2
Up and down	1	3*	3	8.17	4.98	1.62	100.0	11.19	100.0
Contour	2	3		0	5.15	1.69	104.3	10.14	90.6
Up and down	3	2	3	8.27	4.25	1.27	100.0	12.04	100.0
Contour	2	3		0	5.08	1.62	127.5	11.09	92.1
Up and down	3	3*	3	8.27	5.00	1.59	100.0	11.74	100.0
Contour	2	3		0	5.08	1.62	101.9	11.09	94.5

*Engine overloaded, not practical gear.

TABLE 2. PLOWING WHEAT STUBBLE WITH MOLDBOARD PLOW PREVIOUSLY CULTIVATED WITH DUCKFOOT FIELD CULTIVATOR

Equipment: John Deere AR tractor on rubber tires and Vulcan three-bottom 14-in plow.

	Plot No.	Gear Up	Gear Down	Slope, per cent	Average speed, mph	Acres per hour: Acres	Acres per hour: Per cent	Fuel consumption: Pounds per acre	Fuel consumption: Per cent
Up and down	4	2	3	7.30	3.84	1.83	100.0	7.33	100.0
Contour	5	3		0	4.32	2.13	116.4	6.68	91.1
Up and down	6	2	2	7.02	3.39	1.63	100.0	7.41	100.0
Contour	7	2		0	3.43	1.66	101.8	7.19	97.0

TABLE 3. PLOWING WHEAT STUBBLE WITH WHEATLAND DISK PLOW, HAYS, KAN., JULY 1937

Equipment: Caterpillar 22 tractor and Oliver wheatland disk plow.

	Plot No.	Gear Up	Gear Down	Slope, per cent	Average speed, mph	Acres per hour: Acres	Acres per hour: Per cent	Fuel consumption: Pounds per acre	Fuel consumption: Per cent
Up and down	10	2	3	6.21	3.11	2.66	100.0	8.00	100.0
Contour	10	3		0	3.37	2.92	109.8	6.21	77.6

TABLE 4. DISKING PLOWED GROUND, MANHATTAN, KAN., JULY 1937

Equipment: John Deere A tractor and McCormick-Deering 7-foot tandem disk harrow.

	Plot No.	Gear Up	Gear Down	Slope, per cent	Average speed, mph	Acres per hour: Acres	Acres per hour: Per cent	Fuel consumption: Pounds per acre	Fuel consumption: Per cent
Up and down	3	2	2	8.27	3.12	3.07	100.0	5.10	100.0
Contour	2	2		0	3.17	3.11	101.3	4.92	96.5
Disking Wheat Stubble									
Up and down	3	2	3	8.27	4.25	3.93	100.0	3.75	100.0
Contour	2	3		0	5.12	5.06	128.8	3.45	92.0

TABLE 5. LISTING WHEAT STUBBLE, HAYS, KAN., JULY 1937

Equipment: Caterpillar 22 tractor and John Deere five-row No. 751 damming lister.

	Plot No.	Gear Up	Gear Down	Slope, per cent	Average speed, mph	Acres per hour: Acres	Acres per hour: Per cent	Fuel consumption: Pounds per acre	Fuel consumption: Per cent
Up and down	8	2	3	6.46	3.18	3.04	100.0	6.11	100.0
Contour	9	3		0	3.58	3.58	117.8	5.57	91.2

TABLE 6. CULTIVATING WHEAT STUBBLE WITH DUCKFOOT FIELD CULTIVATOR, HAYS, KAN., JULY 1937

Equipment: John Deere AR tractor on rubber tires and John Deere duckfoot field cultivator.

	Plot No.	Gear Up	Gear Down	Slope, per cent	Average speed, mph	Acres per hour: Acres	Acres per hour: Per cent	Fuel consumption: Pounds per acre	Fuel consumption: Per cent
Up and down	4	2	2	7.30	3.31	3.33	100.0	3.86	100.0
Contour	5	2		0	3.35	3.37	101.2	3.47	89.9
Up and down	6	2	3	7.02	3.93	3.85	100.0	3.56	100.0
Contour	7	3		0	4.46	4.48	116.4	3.03	85.1

9 at Hays. This implement has 6-in bottoms and 20-in row spacings. It was necessary to shift gears in going up the 6.46 per cent grade. The acres-per-hour capacity of the machine was 17.8 per cent greater on the contour and the fuel saving was 8.8 per cent.

Tests on a duckfoot field cultivator are shown in Table 6. These were run on uphill and downhill plots 4 and 6 with 7.30 and 7.02 per cent slopes, respectively, and on contour plots 5 and 7. The machine was set to run deep enough, in the tests on plots 4 and 5, to make it necessary to use second gear throughout. The usual slight advantage for the contour is seen in the acres-per-hour column and a fuel saving on the contour of 10.1 per cent is shown. The tests on plots 6 and 7 were run by shifting on the upgrade, and traveling down and on the contour in third gear. A 16.4 per cent time saving and a 14.9 per cent fuel saving in favor of the contour was the result.

Table 7 summarizes all of the tests. They were averaged first on a basis of the gear in which the work was done. An average of all tests in which up, down, and contour travel was in the same gear (either second or third), shows a time advantage for the contour of 1.8 per cent and a fuel saving on the contour of 6.4 per cent. Those tests in which up travel was in one gear lower than down and contour travel, show an average time saving of 20.4 per cent and fuel saving of 11.7 per cent in favor of the contour.

The last two lines of Table 7 are an average of all tests irrespective of gear, machine, or plot. These figures include 52 separate tests, with three tractors and six different implements on ten plots. The average slope of the uphill and downhill plots was 7.56 per cent. Time and fuel savings average 12.8 and 9.4 per cent, respectively, in favor of the contour operation.

The results of draft and power tests are rather involved, due to the effects of the variables of force, distance, and time. The curves in Fig. 4 are an example of draft comparisons of the combined units of tractor and a three-bottom plow. The draft on the contour is seen to fall approximately equidistant between the uphill and the downhill draft. In a comparison of the average of all uphill and downhill draft tests with an average of all contour draft tests it was found that they were practically identical. There was a difference of 0.1 per cent with the combined tractor and implement units and 1.4 per cent with the implements only. This comparison was made at a 3 mph speed in all cases. Therefore, it may be said that the average of the draft uphill and downhill will be equal to the draft on the contour at a given speed.

An analysis of the draft data also shows that on the average the downhill draft of the combined units was about 25 per cent less than the contour draft, and the up-

TABLE 7. SUMMARY OF TESTS

	Plot No.	Gear Up	Gear Down	Slope, per cent	Average speed, mph	Acres per hour: Acres	Acres per hour: Per cent	Fuel consumption: Pounds per acre	Fuel consumption: Per cent
All Tests in Which Up, Down, and Contour Travel was in Same Gear									
Up and down	1,3,4,6	2,3	2,3	7.81	3.96	2.25	100.0	7.86	100.0
Contour	2,5,7	2,3		0	4.04	2.29	101.8	7.36	93.6
All Tests in Which Up Travel Was in One Gear Lower Than Down and Contour Travel									
Up and down	1,3,4 6,8,10	2	3	7.39	3.83	2.55	100.0	7.47	100.0
Contour	2,5,7,9,10	3		0	4.44	3.07	120.4	6.60	88.3
All Tests Irrespective of Gear									
Up and down	—	—		7.56	3.88	2.43	100.0	7.63	100.0
Contour	—	—		0	4.27	2.74	112.8	6.91	90.6

TABLE 8. COMBINED POWER TO TRACTOR AND IMPLEMENT — RESULTS OF TESTS IN WHICH UP TRAVEL WAS IN ONE GEAR LOWER THAN DOWN AND CONTOUR TRAVEL

Equipment	Plot No.	Slope, per cent	Horsepower Up	Horsepower Down	Horsepower Average	Contour plot No.	Contour horse-power
John Deere A tractor and two-bottom plow	1	8.17	13.8	13.2	13.5	2	16.3
John Deere A tractor and two-bottom plow	3	8.27	15.9	16.9	16.4	2	21.3
John Deere AR tractor and three-bottom plow	4	7.30	13.5	11.0	12.2	5	14.7
John Deere A tractor and tandem disk harrow	3	8.27	13.3	9.9	11.6	2	15.4
John Deere AR tractor and duckfoot cultivator	6	7.02	17.2	15.7	16.9	7	21.9
Caterpillar 22 tractor and damming lister	8	6.46	20.6	23.6	22.1	9	25.6
	Average	7.58	15.7	15.0	15.4	—	19.2
	Per cent	—	81.8	78.4	80.1	—	100.0

TABLE 9. COMBINED POWER TO TRACTOR AND IMPLEMENT — RESULTS OF TESTS IN WHICH UP, DOWN, AND CONTOUR WAS IN SAME GEAR

Equipment	Plot No.	Slope, per cent	Horsepower Up	Horsepower Down	Horsepower Average	Contour plot No.	Contour horse-power
John Deere A tractor and two-bottom plow	1	8.17	22.8	13.2	18.0	2	17.1
John Deere A tractor and two-bottom plow	3	8.27	26.1	17.0	21.5	2	21.3
John Deere AR tractor and three-bottom plow	6	7.02	13.6	7.9	10.8	7	10.7
John Deere AR tractor and duck-foot cultivator	4	7.30	14.7	8.8	11.8	5	13.2
	Average	7.69	19.3	11.7	15.5	—	15.6
	Per cent	—	123.7	75.0	99.4	—	100.0

hill draft was about 25 per cent greater than the contour draft. These are also based on a 3-mph speed. The implement draft up the slope and down the slope varied by about 10 per cent above and below the contour draft. It should be kept in mind that these values would apply only to the slopes and equipment considered in this study.

From a power standpoint the picture is somewhat different. Because of a higher average speed of travel, the power requirement was greater on the contour plots than on the uphill and downhill plots. This is to be expected if the average of uphill and downhill draft is equal to contour draft at a given speed. The increase in implement draft due to a speed increase and the effect of the increased speed on power both tend to increase the contour power requirement. By dividing the power data into two groups, (1) those tests in which the up travel was in one gear lower than the down and contour travel, and (2) those tests in which up, down, and contour travel was in the same gear, another comparison is made that has a bearing on the problem. Table 8 shows the first group. It may be seen that the average horsepower of the uphill and downhill travel is less than that on the contour by 19.5 per cent. The horsepower on the uphill travel is about 18 per cent less than the contour horsepower, and the downhill horsepower is about 22 per cent less than the contour horsepower.

A similar comparison of the second case, in which no gear shift was made on the up grade travel, is shown in Table 9. The horsepower on the contour is practically identical to the average horsepower of the uphill and downhill tests. This is as it should be if, as stated before, the average draft uphill and downhill is equal to the contour. Since no shift in gears was made, the speeds were practically equal, as may be seen by referring back to Table 7. However, the horsepower on the uphill travel was about 25 per cent greater than on the contour and the downhill draft was about 25 per cent less than the contour draft.

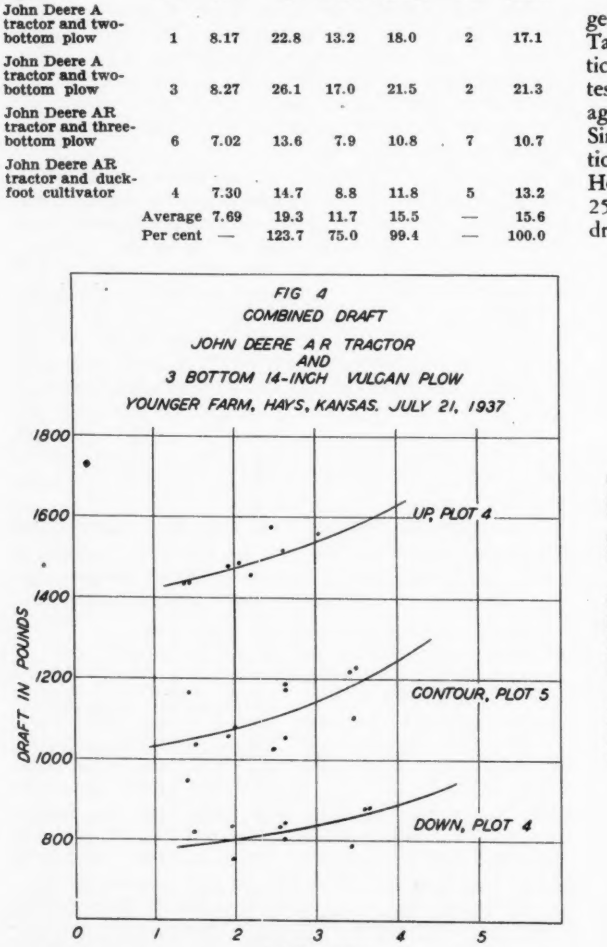


FIG 4 COMBINED DRAFT JOHN DEERE A R TRACTOR AND 3 BOTTOM 14-INCH VULCAN PLOW YOUNGER FARM, HAYS, KANSAS. JULY 21, 1937

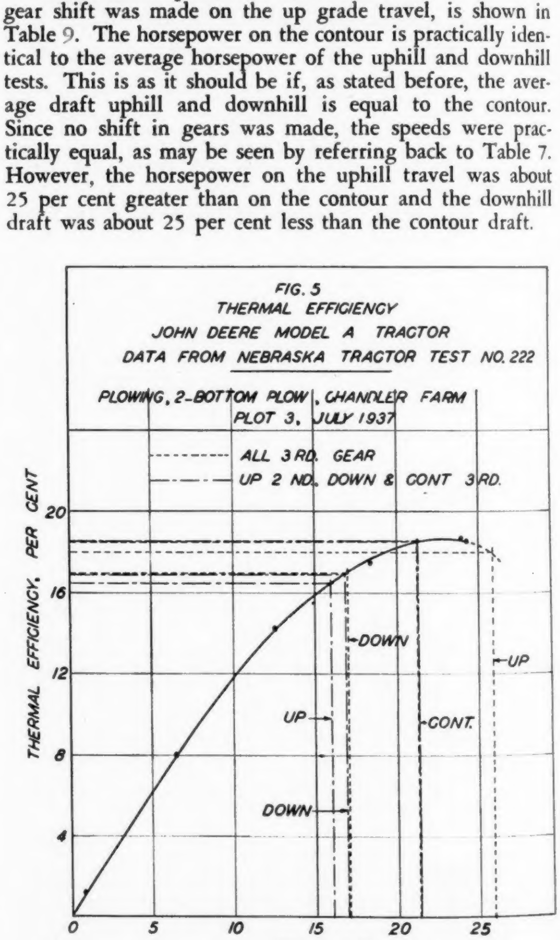


FIG. 5 THERMAL EFFICIENCY JOHN DEERE MODEL A TRACTOR DATA FROM NEBRASKA TRACTOR TEST NO. 222

TABLE 10. SUMMARY OF COMBINED POWER TO TRACTOR AND IMPLEMENT IRRESPECTIVE OF GEAR

Equipment	Plot No.	Slope, per cent	Horsepower Up	Horsepower Down	Horsepower Average	Contour plot No.	Contour horsepower
All	Average	7.62	17.2	13.7	15.5	—	17.7
	Per cent	—	97.2	77.4	87.3	—	100.0

The power summary table shows, for the various tests made, 13 per cent less power was required on the uphill and downhill plots. It should also be recalled that the uphill and downhill plots required about 13 per cent more time (12.8 per cent, Table 7) to do the job than was required on the contour. If such is the case, the energy requirements are about the same for both farming practices. There remains, then, the fuel saving of between 9 and 10 per cent in favor of the contour practice, for which to account.

It is believed that power data, when applied to a typical thermal efficiency curve of a tractor engine, explains in part the fuel saving on the contour. Such a curve is shown in Fig. 5. Since the power the engine must develop to pull the implement, as well as propel itself, is represented very nearly by the combined power requirement for pulling the tractor and implement, and since this should be fairly close to the brake horsepower the engine would be developing, then the curve of brake horsepower and thermal efficiency may be used for the purpose of illustration. Take, for example, the data on the John Deere A tractor and two-bottom plow, plot No. 3 in Table 8. The uphill horsepower was 26.1, the downhill horsepower was 17.0, and the contour horsepower 21.3. These, placed on the thermal efficiency curve, show efficiencies of 17.8 per cent, 16.9 per cent, and 18.6 per cent, respectively. The uphill and downhill efficiencies average 17.3 per cent, or about 7 per cent less than the contour efficiency. By placing on the same curve data from Table 8 of the John Deere model A tractor and two-bottom plow, plowing on plot 3, in which the uphill travel was made in one gear lower speed, the results are as shown: 15.9 hp up hill, 16.9 hp down hill, and 21.3 hp contour, with thermal efficiencies of 16.5 per cent, 16.8 per cent, and 18.6 per cent, respectively. The average uphill and downhill efficiency, considering the difference in time at which the engine would have operated at each, since the engine operated a longer period of time on the uphill travel, is about 16.6 per cent, or about 11 per cent less than the contour efficiencies. It is apparent that, in general, in normal field operation the combination of the efficiencies of the uphill and downhill work will be less than for contour operation. This will be the case invariably if the average horsepower on the uphill and downhill travel is equal to or less than the horsepower on the contour.

Another loss incurred when operating on the up-and-down grade, which tends to increase the fuel consumption above that on the contour, was increased tractor drivewheel slippage on the uphill travel. This was observed but not measured. It was particularly noticeable when the uphill travel was made in the same gear as the downhill and contour travel.

It was found when plowing on the contour, when an equal number of furrows had been made on the upper and lower sides of the land, the lower side would consistently measure greater in width than the upper side. Average contour land widths, however, were equal to uphill and downhill land widths. When plowing on the contour around a backfurrow, on a slope of about 8 per cent, land widths averaged 5 per cent wider on the lower side. Fuel consumption and draft also were greater by about the same percentage on the lower side of the land. This can be attributed, no doubt, to the tendency of the plow to slide down hill, cutting a wider furrow on the lower side of the land than on the upper side. The fact that the soil is thrown up hill when travel is along the lower side of the land should have little or no effect on the energy required, since the soil leaves the moldboard with a given velocity and energy, irrespective of the place or direction it is to fall.

ACKNOWLEDGMENTS: Credit is given to L. C. Aicher, superintendent of the Fort Hays Branch Agricultural Experiment Station, for the use of station equipment, and to F. G. Ackerman, in charge of soil and water conservation investigations at the station, for assisting with the work at Hays.

Farm Tractor Fuel Trends

(Continued from page 152)

Some conclusions as to farm tractor fuel trends which may be drawn from the foregoing, are as follows:

1 So far as the tractor manufacturer who sells in a world market, is concerned, it is plainly evident that engines must be made available for burning tractor distillate in territories where gasoline prices and gasoline taxes are high. A large proportion of farmers, however, under present conditions will prefer to burn gasoline.

2 On the basis of fuel costs set up in the accompanying table, the lowest operating costs can be obtained by burning tractor distillate. Even when gasoline is untaxed, distillate should cost $25.00 less per year than gasoline. If distillate is to be used, the fuel should be purchased on a specification of 525 F end point and a minimum of 35 octane. Fuels meeting these two specifications are almost universally available and their use makes possible increased power, as well as decreased consumption, as compared with zero octane fuels and fuels with 600 F end points.

3 Gasoline, when burned in an engine having the highest practical compression ratio will, on the basis of tabulated figures, cost only about $25.00 per year more under tax-free conditions, but $60.00 per year more if taxed 5 cents per gallon, than when burning distillate. A possible saving of $60.00 per year will influence many to burn the cheaper fuel. The value to be placed on the additional power available and on the convenience of operation will have to be decided in each case individually.

4 At 1 cent per gallon premium, 70 octane gasoline in an engine with 5.5 to 1 compression will cost no more for operation than 55 octane gasoline in an engine with 4.8 to 1 compression. The additional horsepower is free.

5 It is poor economy to burn gasoline in an engine with the low compression required for tractor distillate. Not only is the fuel consumption high, but horsepower is restricted. When conditions favor the use of gasoline, the engine should be built to burn gasoline most economically.

6 The trend of farm tractor fuels will be determined by the purchasers of tractors, and the tax situation is a big factor in determining the trend.

Unit Equipment in Farm Homes

By Ellen Pennell

IN MY contacts with various equipment manufacturers, I have had an opportunity to see many different types of unit equipment in use, both in kitchens and laundry rooms. Manufacturers have done many things toward home improvement. They have simplified work procedure in both the kitchen and laundry with unit equipment.

Wood and metal cabinets are available for any size of kitchen. This should be gratifying to everyone, since the subject of kitchen size can keep an argument going indefinitely. There are those—and I am one of them—who say the farm kitchen should be small and compact. Others insist that they need the large square affair, where meals may be prepared in one corner and served in another, with the children's play pen in a third, father's favorite chair in another spot, and a place for mother in the space remaining to entertain guests as she works.

Strangely enough, this problem of kitchen size almost becomes a geographic one. The old rambling farm house of the East and South still spreads its influence for large kitchens. The farther west we go, the more there is a trend towards the smaller house and more compact kitchen.

Unit equipment controls the procedure of work by placing cabinets around the three major pieces—the refrigerator with preparation space, the sink with dishwashing and cleanup space, and the range and serving center. With these placed in proper relation to one another, they will naturally fall in line on an end or side of a kitchen, and the rest of the space may be large or small, according to the wishes of the family.

The best plan is to use two corners with three walls in arranging these units. This results in the U-shaped kitchen. Another good arrangement utilizes one corner and two walls, and results in an L-shaped work area. This may be modified to meet the need.

It has pleased me to find that designers and engineers have recognized the importance of small details when working out these units. Here are a few small conveniences introduced by unit cabinets that receive high praise:

1 Drawers in these cabinets are much more convenient than serving doors. They eliminate stooping and reaching for items. These cabinets may contain storage bins for flour, sugar, and meat, storage bins for a one or two days' supply of dry vegetables; properly partitioned cutting tray; vertical storage of lids, trays, and other flatware, and bread and cake drawers.

2 A cabinet beneath the sink is put to many uses. There are soap and cleansing powder racks on backs of doors of sink cabinets. I know of one company that recently installed a beautiful kitchen which is always on display. The trick that attracts most attention is the refuse pail attached to the back of the sink cabinet door. As the door is opened the lid of the container opens to receive any waste from the sink.

3 Step shelves for placing small items of varied size and shape in cabinets above the sink, all catch the eye of the homemaker.

4 Electricity has brought built-in lights, plate and towel warmers, and driers concealed behind innocent looking kitchen cupboard doors.

5 The space beneath cabinets and attractive shelves around windows add to the convenience and beauty of these models.

The same smart ideas are presented in laundry room equipment. Cabinets, tubs, machines, and tables are all planned to save steps and make the otherwise drab part of the house a showplace and pride of the homemaker. Clothes baskets on wheels almost follow the woman around the room. And to tempt us further are wall cabinets for telephone, cleaning supply cabinets, and even linen cabinets. All of these prove that much thought has gone into this detail of home improvement.

As I enumerate these devices and conveniences, I begin to feel as if I am nearing fairyland, instead of talking about practical kitchen cabinets and accessories. Then suddenly I am brought back to earth with the very question suggested for this program. Are equipment units practical for the farm family? Will they fill requirements of farm kitchens? And, finally, are they within financial reach?

I can imagine nothing finer than simply sending kitchen floor plans and ordering the cabinets to come all ready to install. It would do away with many a weary session with the local carpenter who has built only one kind of cabinet for years, and doesn't intend to bother his brain about changing it.

There are many problems with some mill work, too. It is almost impossible in many areas to get any satisfactory millwork. It has to be shipped long distances and then oftentimes does not fit. It is bulky to transport and, if sent by rail, the farmer has difficulty in getting it out to his place. If sent by truck, it is sometimes exposed to bad weather and damaged before it arrives. I believe that if some of the companies manufacturing metal equipment would become interested in the rural field, a great many more farm families would consider rearranging their kitchens.

Presented before the Farm Structures Division at the fall meeting of the American Society of Agricultural Engineers at Chicago, Ill., November 30, 1937.

Author: Editor, homemaking department, "The Country Home." Assoc. A.S.A.E.

Lightweight Concrete Aggregate

A LIGHTWEIGHT concrete aggregate is now being made by a patented process for converting molten basic pig iron slag into a vitreous clinker of porous, cellular structure. Slag as it is run from the furnace is treated with water of controlled volume and temperature to produce the desired result. The clinker is graded to size by crushing and screening.

Production cost is said to be minimized by utilizing the initial heat of the slag as it runs from the furnace. Distribution cost will be minimized by production at various ore reduction points throughout the East and Middle West. The potential supply of slag is practically inexhaustible. Immediately available supplies are conditioned principally on the rate of steel industry operations, which are generally proportional to construction activity.

Further tests are being made by disinterested agencies on strength, heat resistance, and other properties of concrete made with this aggregate. Indicated uses include concrete for fireproofing steel, for floor systems, long-span bridge decks, monolithic structures, roofs, lightweight building tile, and other prefabricated forms.

Steel Units in Building Construction

By R. H. Driftmier

STEEL and concrete have been used successfully for structural purposes for over fifty years. So much has been achieved by the metallurgist, the manufacturer, and the designer that, if careful consideration is given to design and construction, steel framework can be relied on for strength and safety. At the same time it conforms most readily to architectural, aesthetic, and economic requirements.

Steel framing makes possible fire-resistant floor, wall, and roof construction; eliminates shrinking, warping, and decay, and permits speed, strength, rigidity, and lightness in erection, since it has high resistance to tension and compression stresses, as well as to flexure and shear.

The agent most destructive to structural steel is corrosion. Corrosion can be controlled either by providing a dry atmosphere, by encasing the steel in a solid, or by painting.

The buildings constructed under my supervision during the past two years have resulted in the accumulation of much valuable information. Our experience has shown us the possibilities of the light-load steel frame and what is involved in its design, fabrication, erection, and finish. All of the problems have not been solved, nor have all the questions been answered. However, we do know that the steel frame can be practically applied and utilized for building construction, and its cost is not excessive, compared with that of other first-grade materials which it displaces. The type of architecture which may be followed in the design is unlimited.

Two types of frame have been developed, one similar to the ordinary stud and joist construction of wood, the other a skeleton frame analogous to that of the skyscraper. This paper will be limited to a discussion of the stud and joist construction, as used on our projects.

Of paramount importance in visualizing the application of light-load steel framing is its similarity to wood-frame construction. The various portions of the steel frame are named to correspond to wood members; the order and methods of framing are parallel to the best practice in handling wood. However, in my opinion, since our fabrication was done by welding, the analogy should end here. Although an experienced carpenter may assist in laying out the work, only experienced and well-qualified welders should fabricate the steel frame.

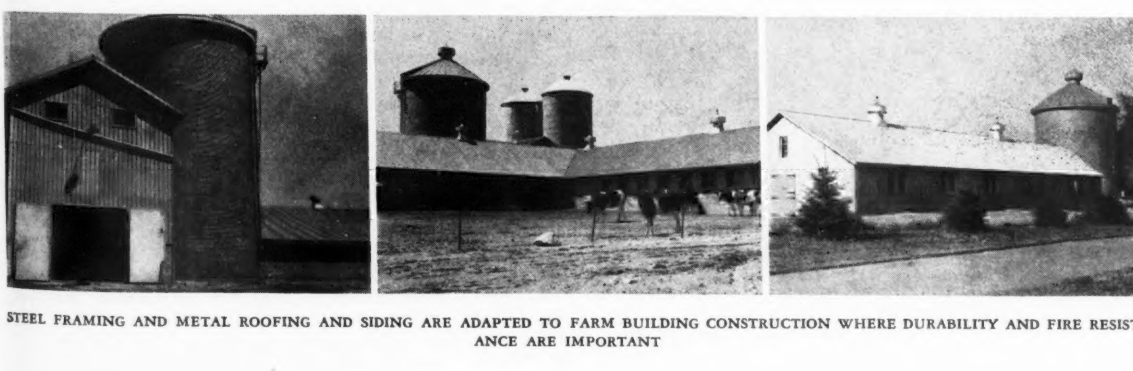
The designs indicated on our drawings, open lattice web steel studs and floor joists, and described in our specifications were set up as a guide and standard of quality. Steel joists conforming to the specifications of the American Steel Joist Institute were acceptable. Acceptable designs of steel studs included structural steel channels, single or double channels, expanded lattice web, H columns, or built-up angles with lattice web members or equal, designed and spaced to carry the specified loads.

All assembly and erection were accomplished by electric arc welding in the field. Our specifications require the use of a 150-amp, or larger, arc welding unit. Unless the engineer and/or architect specifies otherwise, the studs are furnished cut to the principal vertical lengths according to the customer's list. Studs for framing around doors, windows, and other openings are furnished in stock lengths, to be cut and fitted on the job. This means that the wall studs will be sheared to length and that the latter framing members will be cut to length with the acetylene torch. We have found, however, that much better results can be obtained by sawing these members to length. The additional cost for such procedure will be more than offset by the speed of erection and the elimination of shims, warped members, and poor welds.

The first members used in the construction are $\frac{1}{4}$x$4\frac{1}{2}$-in sill plates, made continuous by welding and anchored to the reinforced concrete foundations with $\frac{1}{2}$x10-in bolts spaced 4 ft on centers. The wall framing may be either balloon or platform construction. We prefer the platform method since it facilitates assembling the wall panels on the ground or floor. The girth used to cap the studs at the second floor level is a $\frac{1}{8}$x$4\frac{1}{4}$-in channel with $2\frac{1}{2}$-in legs. Studs are tripled at corners, being welded together with straps for stiffening. Studs are spaced 24 in on centers, taking up odd distances in end spacing. Window and door openings are framed in accordance with usual wood construction practice. We recommend trussing all openings, using $1\frac{1}{4}$x$\frac{1}{8}$-in concaved flats placed as tension members. Studs are welded to girth with $\frac{1}{8}$-in fillet welds $1\frac{1}{8}$ in long. The panel is next placed, plumbed, and the studs

Paper presented before the Farm Structures Division at the fall meeting of the American Society of Agricultural Engineers at Chicago, November 30, 1937. (NOTE: This paper appears here in condensed form. Mimeograph copies of the original may be obtained by A.S.A.E. members on request to Society headquarters.)

Author: Professor of agricultural engineering (head of the department), University of Georgia, and supervising engineer, Regents University System of Georgia. Fellow A.S.A.E.



STEEL FRAMING AND METAL ROOFING AND SIDING ARE ADAPTED TO FARM BUILDING CONSTRUCTION WHERE DURABILITY AND FIRE RESISTANCE ARE IMPORTANT

welded to the sill plate with the same weld as for girth. Prestressed concave flats are then welded in as horizontal bracing for each 6 ft of unsupported height. Diagonal sway bracing is installed next. Either $\frac{1}{8}$x$1\frac{1}{4}$-in plain or concave flats may be used. We prefer the concave member since we were able to secure more effective bracing than with the plain flat. The diagonal brace is welded to the stud at the bottom and then prestressed and drawn tight by means of a ratchet, or similar device, at the other end of the diagonal, pulling the panel slightly out of plumb. Then the other diagonal is installed and the panel drawn back into plumb. The strap is then welded to each stud, making sure that the studs are plumb. The floor joists are next erected alongside each stud and are welded to sill or girth and to stud. Whenever a load bearing member rests upon the girth at a distance of more than 8 in from the nearest supporting stud, the girth is reinforced. Likewise, when framing over or under a bearing partition the girth or joist is reinforced with plates welded in as struts. Joists are bridged once in a span up to 14 ft, twice for spans 14 to 21 ft, and three times for spans between 21 and 32 ft. Two types of bridging can be used—horizontal bridging composed of 1x1x$\frac{1}{8}$-in angles coped out for the joist spacing, or rigid diagonal bridging.

It should be emphasized that until the entire framework is completely assembled and permanently welded together, great care should be taken to keep it braced or guyed to prevent swaying or buckling and to insure that the entire framework will act as a unit. The framework should be electrically grounded at not less than two points located in or near opposite walls.

FLOOR SYSTEM, PARTITIONS, AND FINISH

The floor system used with the light-load steel framing consists of four essential elements, namely, (1) steel joists or other structural members, (2) material used to support and reinforce the slab, (3) the slab, and (4) ceiling underneath. In our designs we used steel joists conforming to the specifications of the American Steel Joist Institute. Junior I beams are also satisfactory. The steel joist facilitates installation of plumbing, heating, and electrical equipment.

The slab over the joists may be precast or poured. With precast materials such as gypsum, concrete, or nailer concrete, the top lath is omitted. We do not recommend cinder concrete for use over steel joists.

Where the finish floor is to be asphalt tile or similar material, a full 2-in slab is sufficient. If the finish floor is to be wood, unless nailer concrete is used, wood screeds will be required. Then in order that at least 1 in of concrete may be provided below the screed, chairs or so-called sleeper anchors are provided, which are attached to the top chord of the joist and at the same time hold the screed 1 in above the top chord of the joist. A $2\frac{1}{2}$-in slab with temperature steel is recommended if the slab is to be cement finish.

Many types of construction are available for interior partitions, including partition tile of gypsum or clay, precast slabs, solid plaster and/or steel studs or channels, all with the many types of applied finish material. In our dormitories we used the 2-in solid plaster with varying degrees of success, and 3-in partition tile, plaster finish. With the 2-in solid plaster partition parallel with the joist, it is not necessary to add an extra joist under the partition, since this type of partition tends to act as a structural member bridging the floor span.

Since our buildings were plaster finish throughout, all ceilings and side walls were covered with $\frac{3}{8}$ in, 3.4-lb painted rib lath with ribs up against lower chords of steel joists and in against faces of steel studs. All plaster work was three-coat, full $\frac{3}{4}$-in thick.

The outside finish for steel framing may be stucco, stone, brick veneer, or of materials used as ashlar, anchored to the steel studs. A continuous membrane of paper-backed lath or fabric furred out from the studs by horizontal bars or straps, or certain types of composition board, all rigidly fastened to the studs, will serve as a stucco base. Brick veneer may be backed up by a 1-in parge coat on paper-backed lath or composition board, or the masonry may be separated by a 1-in air space from insulating board covered by building paper. We have tried three types of construction with brick veneer. We have found that when paper-backed lath is parged (mortar applied with trowel under pressure) thoroughly with a waterproofed mortar and the remaining space slushed full, that the resulting backing will act as a continuous waterproofing and stiffening membrane. Then if the face brick, conforming to tentative specifications of the A.S.T.M. serial designation C-62-36-T, are laid with close-shoved joints in waterproofed lime, cement, sand mortar, or waterproofed prepared mortar passing federal specifications SS-C-181, there is not much possibility for the entrance of water from the outside. We also provide continuous flashing at the base of the studs around the entire building with weep holes through the veneer.

Steel framing is well adapted to roof construction. For pitched roofs, regular floor joists spaced on same centers as studs may be used. The joists are ordinarily furnished to approximate lengths with separate loose-end web plates. These joists should be fitted to ridge plates and other roof members and then the end struts may be installed to fit. Poured or precast slabs of nailing concrete may then form the base for the finish roof. For flat roof construction, the front wall studs were cut enough longer than the rear wall studs to provide the proper pitch for drainage. A 2-in concrete slab with suitable expansion joints was then placed. Crickets were built on this slab for drainage to downspouts. Scuppers were installed in the parapets at each downspout to preclude overload in the case of strainer stoppage. We then applied 20-yr bonded built-up roof and flashing. On pitched roofs, since the ceiling of the second or top floor consisted of steel joists overlaid with a 2-in concrete slab, we used wood framing and sheathing. In case of fire the roof might be destroyed, but the contents of the building, together with its occupants, would be protected.

The roof construction used on our new dairy barn at the University of Georgia may be of interest. It consists, in general, of individual trusses built up with 12-in joists, 4-in studs, and supplementary angles and straps. Each truss is welded to a ridge plate and to the bolted-down sill. The inside finish was plaster on metal lath. A $\frac{3}{8}$-in, 4-lb top lath was clipped to the trusses, and this in turn was overlaid with a 2-in topping of nailing concrete.

No attempt has been made to present any data on cost. We know of course what each building cost. We can thus arrive at square foot and cubic foot costs. The thing we do not know is the amount of the contractor's profit or loss. However, based on our experience, we believe that light-load steel framing, as we have used it, offers an intermediate type of construction (from a cost standpoint) between wood framing and the conventional forms of fireproof construction. The steel frame, in our opinion, offers unlimited possibilities as the structural system for a home which will be economical in that it is durable, safe because it is fire-resistant, and acceptable since it does not restrict architectural style.

Sprinkler Irrigation in the Humid Sections of Oregon

By F. E. Price

IRRIGATION by sprinkling has been practiced in western Oregon for more than twenty years, but rapid expansion of this method of irrigation has taken place in the last four years. This has been closely associated with development of portable pipe for laterals and revolving sprinklers to cover areas 80 ft in diameter.

The one system of sprinkler irrigation that was used almost universally, previous to about five years ago, was the overhead pipeline sprinkler with single brass jets screwed into the line 3 or 4 ft apart. Ordinarily a pressure of 30 lb was maintained at the nozzles. The sprinkler line was then rotated on supporting rollers sprinkling 25 ft on each side of the line, or a total width of 50 ft. This required that sprinkler lines be placed at intervals of 50 ft.

Ordinarily only sufficient sprinkler line was installed on each farm to handle the quantity of water which was being pumped, and the lines were then moved to another set of posts. Hydraulic oscillators were sometimes used to rotate the sprinkler line so as to sprinkle the entire 50-ft strip without attention. More commonly the lines were rotated by hand.

This system was used quite extensively in the vegetable-growing districts of western Oregon, and particularly in the vicinity of Eugene, where 800 to 1,000 acres of vegetable crops are grown for canning. Few other crops were irrigated by sprinkling until 1932, except an occasional crop of mint.

Irrigation of vegetable crops was passing through its test period in this area in 1923 to 1935. The few irrigation installations which were made were watched by other growers with much interest and with much questioning as to their value. Most growers insisted that irrigation was not necessary in an area having an annual rainfall of 40 in, although very little of this rain came during June to September. This was also a test period for observing the comparative merits of sprinkler and furrow irrigation, as both methods were being used.

String beans or pole beans were one of the important cannery crops on which the value of irrigation was tested. The nonirrigated beans were producing ½ to 1¼ tons per acre, while the irrigated beans produced 5 to 6 tons per acre, and the latter were of greatly superior quality. The gross returns for the nonirrigated beans were $30 to $80 per acre, while the irrigated beans made returns of $150 to $400 per acre gross, a gain of $120 to $320 per acre. The cannery management soon settled the question of irrigation of string beans by contracting only irrigated beans, because of superior quality.

This was only the beginning, because irrigation gave growers an opportunity to increase yields by improving the fertility, so that now yields of 10 to 14 tons of string beans are common, and in addition an excellent cover crop is assured after the string beans are harvested.

In this same area table beets for canning are increased 150 per cent in yield by irrigation. Carrots for canning yield 36 tons per acre under irrigation compared to only 12 tons without irrigation.

During this test period sprinkler irrigation was greatly preferred by growers. Some growers had both sprinkler and furrow irrigation on one farm, but it soon became apparent that irrigation by sprinkling was preferred on a great majority of the farms.

Local conditions which caused this preference are somewhat apparent. The best vegetable land was adjacent to the Willamette River and subject to overflow, and was therefore not of uniform slope. The area was also completely electrified and power rates were low. Leveling was expensive and often disastrous because of gravel bars be-

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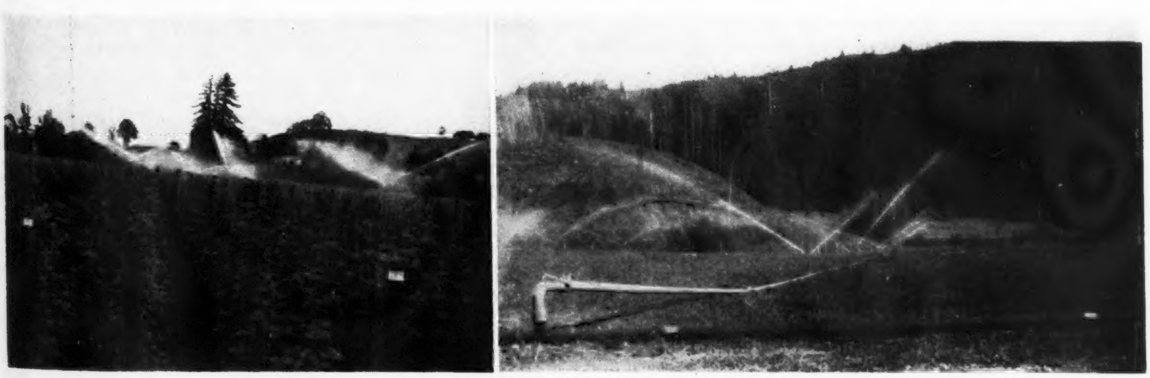
Author: Agricultural engineer, Oregon Agricultural Experiment Station. Mem. A.S.A.E.



(LEFT) IRRIGATION OF STRING BEANS BY SPRINKLING, LANE COUNTY, OREGON. (RIGHT) IRRIGATION OF PASTURE BY SPRINKLING. BOTH SPRINKLER AND LATERAL LINES ARE PORTABLE

neath the high points. Irrigation by sprinkling still stands as the almost universal method of irrigation of vegetable crops on 1,000 acres in this vicinity.

Irrigation by flooding is the recommended method for forage crops in western Oregon, where topography and water supply permit. There are many farms where there is either a limited water supply or the topography is irregular, making flood irrigation difficult or impractical.

In 1931 a study was started by the Oregon Agricultural Experiment Station to determine the feasibility of sprinkler irrigation of pasture for dairy cows. The farm where this study was made had a maximum water supply of 100 gpm during the summer, and the field was quite rolling. A $3\frac{1}{2}$-in (outside diameter) main and 2-in laterals were used. The laterals were placed 180 ft apart and 75 ft of 1-in hose was used on each hydrant. The hydrants were 180 ft apart. A 5-hp electric motor was used to drive a centrifugal pump which delivered 100 gpm. Ten revolving sprinklers each covering a circle 75 ft in diameter were used.

This installation was made at a cost of $50 per acre, using second-hand pipe and new 1-in hose. The power cost amounted to $7.50 per acre per season, for six irrigations. The pasture carried three cows per acre for six months. Labor to move the sprinklers and attend to the pump amounted to $1\frac{1}{2}$ to 2 hr per day for one man. This project stimulated interest in large-circle revolving sprinklers, and since that time there has been a steady expansion of this method of irrigation for vegetable crops and dairy pastures.

A trial installation was made on the Webber Dairy Farm in Tillamook County in 1933 by the Mountain States Power Company. This is in a district having an annual rainfall of 95 in, but very slight rainfall during the summer months. Accurate records of the butterfat production for the two preceding years were available for the 44 cows on this farm. In 1934, 12 acres of irrigated pasture increased the production of this herd by 1378 lb of butterfat over the average of other two previous years. The value of this increase at the average butterfat price received in that area of 29.1 cents was $401. The following year this farm had the same 44 cows on approximately 20 acres of irrigated pasture, and the production increased to 2108 lb of butterfat more than without irrigation, with a value of $613. In addition to this there was a considerable saving in feed purchased. The cost of electric power for irrigation was approximately $5.00 per acre for the season.

Mr. Webber purchased the equipment from the power company as a result of this demonstration. This installation was first used for the pasture season in 1934. In 1937 there were 35 revolving sprinkler installations used in Tillamook County to irrigate pastures for dairy cows. They are mostly 5-hp installations, with an occasional $7\frac{1}{2}$-hp installation. These irrigated pastures are usually about 20 acres in area, although some are larger. Such installations cost approximately $1,000.00, and the dairymen are consistent in their reports that they pay for themselves in two years.

There has been one distinct change in sprinkler irrigation equipment since 1933. Portable galvanized pipe made in 20-ft sections with special rubber gaskets and quick couplers are being used instead of permanent laterals and rubber hose. The portable lines can be moved in 30 to 45 min. The 5-hp 100-gpm installations usually have a 4-in main of light-weight steel pipe, with Dresser couplings to which 3-in portable laterals are attached at 60-ft intervals. Usually ten revolving sprinklers covering areas 75 to 80 ft in diameter are used. Even the main pipe line is easily moved to another field if the pasture is to be rotated with other crops. In most instances, the water is pumped from streams although there are some shallow well and deep well installations.

This program was attractive to the dairymen in this area because it has proven very profitable to them. It is attractive to equipment dealers because 55 new farm sprinkler irrigation systems were sold and installed in Oregon for the 1937 season. This represented about $50,000 in sales. Most of these systems were powered with 5-hp electric motors. It was attractive to the power companies because these units operate night and day nearly every day in the month for three months, except for the time required for moving. These 5-hp electric motors each consume 2000 to 3000 kwh per month during the irrigation season.

This is also an attractive rural electrification program in Oregon for all parties concerned, because installations of this type are likely to show a substantial annual increase for several years.

Streambed Sediment Load Testing Laboratory

SEDIMENTATION studies will be made by the U. S. Soil Conservation Service with the help of this laboratory built for it by the Works Progress Administration of North Carolina on Rocky Creek in Iredell County. The visible concrete vein walls are five feet apart and segment the stream from side to side. A system of pumps, pipes, and valves permits bed load samples to be taken from any segment or combination of segments for any condition of stream flow. Studies are planned to increase information on how to prevent depletion of reservoir capacity, nature of sediment load-filling reservoirs, relationships between sediment load and hydraulic functions of a stream, damage by runoff to a particular watershed, limits of justifiable expenditure and best methods to control soil erosion, conservation of stream navigability, and prevention of flood damage. Similar laboratories are being installed at Greenville, South Carolina, and Dadeville, Alabama.

REA Program Makes Progress

By Oscar W. Meier

ENOUGH time has now elapsed to give some basis for appraisal of the program of the Rural Electrification Administration on the sound standard of actual accomplishment. On November 22, 1937, the date of the last progress report available at the time of this writing, loan contracts had been executed for 321 projects which, when completed, will embrace 73,196 miles of distribution lines, and allotments have been made for another 29 projects which will add 6,933 miles more. REA is now advancing funds to pay for accepted construction at the rate of about 1¼ million dollars per week. Ninety-four projects have been energized in whole or in part. As of the above date, the average cost of construction on completed mileage was $946.20 per mile. This figure includes transformers, meters, engineering, and legal fees, even to the cost of obtaining easements.

PROBLEMS OF RAPID EXPANSION

As might have been expected, many problems arose in the launching of so vast a program in so short a time. Some have been solved, others await solution. On the whole, however, we feel that something definite has been contributed to the techniques of rural electrification in America. First of all, it was necessary for our engineers to draw up plans and specifications to be used in the construction of these lines. To get rural lines built at the per mile cost given above, it was necessary to evolve specifications for construction radically different from those in general use up to that time. Our engineers take considerable pride in the fact that the general methods embodied in the plans and specifications which they drew up, are now the accepted standards for rural line construction all over the country.

A second major problem was that of proper sizing of transformers. Under the piecemeal construction of the past, the two or three transformers necessary at any particular time could be taken out of stock by the utility and hung in place. This was not so in the case of REA projects. Here the order for virtually all the transformers to be used on a project had to be placed at once. We found that no simple formula was available for determining just how proper transformer sizes could be accurately determined. The customer surveys which had been made were of little value in making these determinations. This was because the farmer who had never had electric service, knew little about its possible uses. He was thinking principally in terms of electric lights, a radio, and a few other limited household uses which had attracted his attention in the homes of his friends and relatives in the town or city. A few wanted to substitute electric power for the tractor in doing certain belt jobs around the farmstead. Most of them thought of an electric motor big enough to do the job in the same way as they had been doing it with tractor power. They knew little of the relative costs of motors, of wiring, of transformers, and of transformer losses incurred when they attempted to perform a high demand occasional job with electricity.

In the first few months of operation, newly formed projects employed only an attorney and an engineer. It was evident that there were many tasks to be done which fell outside the functions of either of these individuals. Therefore now, immediately after allotment of funds is made, a project superintendent is appointed. This individual acts in a managerial capacity during the period of construction. At the end of that time he may or may not be employed by the board of directors as the permanent manager.

Among the several duties of the project superintendent are those of securing easements, signing the prospective customers on a definite membership and electric service application, making a wiring survey, and securing data on the financing needs of a member, together with certain farm management data that will indicate the potential possibilities of this farm in the use of electricity. He does not personally have to do all of these things, but he is responsible for seeing that they are done. The collection of this data serves a number of purposes, as follows:

1 The customer agrees definitely to take service when it is offered.

2 He indicates whether or not he desires to participate in a group installation plan for wiring his premises; he checks his wiring requirements as he sees them at the present time.

3 He indicates the principal pieces of equipment which he expects to use within six months, and within two years.

4 He indicates whether or not he needs financing for the installation of wiring or equipment.

5 He gives a general outline of his farming operations, which enables the project to estimate his future needs.

GROUP BIDDING FOR EFFICIENT, LOW-COST, HIGH-QUALITY INSTALLATIONS

At this point it is appropriate to discuss in some detail the group bidding plan. We found that there were no uniform standards among wiring contractors for bidding on wiring jobs, either in groups or singly. The contractor who desired to do a conscientious job was faced with the costly procedure of soliciting his work over a wide area and of submitting bids on no one standard. Thus another wireman could come along and make a lower bid in total cost, but often this would be on an inferior job. The jobs that the contractor finally did get were often so widely scattered that much time was lost in traveling from job to job and between the widely scattered jobs and the shop. To meet this problem REA has (1) made financing available for wiring individual farm premises, and (2) drawn up approved wiring specifications and suggested procedures for group bidding (GIF 15 R3 Wiring). These procedures include instructions to bidders, specifications for wiring, contractor's proposal, and bidders' qualifications.

For purposes of bidding, the farms are ordinarily divided into groups of twenty-five or more located in the same general area. The contractor makes his bid on a unit basis with all material and labor installed in place and

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Presented before the Rural Electric Division at the fall meeting of the American Society of Agricultural Engineers at Chicago, Ill., December 1, 1937.

Author: Utilization division, Rural Electrification Administration, Assoc. A.S.A.E.

completed. After the contractor has been awarded the contract on any group, he goes to each farm and writes up a definite work order stipulating where work is to go and inserts prices in accordance with his group bid. Prior to his coming the customer has received from his local association a wiring check list and certain literature furnished by REA designed to impress him with the necessity of planned, safe, and adequate wiring. After the work order has been written, the contractor brings it to the project superintendent for the latter's approval. If the customer is being financed, the project superintendent gives the contractor the customer's contract for payment and customer's note made out in the name of the cooperative, with the proper sums filled in. The contractor is also given the customer's form for certificate of satisfaction. The contractor is then ready to deliver his materials to the job, and at that time he collects from the customer a minimum down payment of 20 per cent. While there the contractor has the customer sign the contract for payment stipulating the terms of payment and also the note for the funds which he is to receive from the cooperative. When the job is completed the contractor gets a certificate of inspection and approval from the authorized inspector, and has the customer sign a certificate of satisfaction.

All these forms are then turned over to the project superintendent, and a requisition for funds is sent in to REA with customer's note or notes attached. A sum having previously been allotted to the project for the purpose of making these advances, the latter procedure takes only a few days time, and then the contractor is in a position to receive his pay in full for the wiring job which he has completed.

While it is not necessary to have group bidding in order to obtain this REA financing, we find group bidding is steadily gaining in popularity. On the North Carolina Caldwell project, for instance, approximately 1,000 wiring installations were made under this group plan; on the Lincoln County, Wyoming, project approximately 500 were made; at Bradford, Pennsylvania, approximately 350 participated. Where this group bidding plan has been put into effect, the prices invariably have been materially lower than the prevailing quotations had been. For instance, on the Ravalli, Montana, project, costs per outlet had been running around \$3.75. Under group bidding the price was \$2.25. On the North Carolina project previously mentioned the prevailing prices were \$2.50; the group bid was \$1.75. On the Lancaster, Virginia, project the group bid price was \$1.51 per outlet. The standard specifications are proving so satisfactory that they are now being used on all projects, regardless of whether REA wiring financing is being used.

INSPECTION INVOLVES PERSONNEL PROBLEM

In order to meet the requirements for proper inspection outlined in the wiring specifications, we faced a real problem. Only five or six states have laws requiring inspection for all premises, both urban and rural, which are wired for electric service. Only urban users of electric service have the protection of municipal laws covering inspection. REA believes that all new users of electric current should have the protection of adequate inspection. We found a lack of qualified men to do this work. The result has been no inspection at all in some instances, or long and serious delays on other projects.

To correct this situation REA has set up a system for training inspectors. On the projects where no inspection service is available, trained electricians are selected who are of high integrity and good standing in the community. After these are selected, we attempt to have a school held for their special training in wiring inspection according to underwriters' requirements. These schools are being held under the direction of state directors of vocational education, fire underwriters, or others qualified and available. After training, these men are appointed as accredited inspectors of the fire marshal's office, or state inspection bureau, thereby making the inspection service independent of electrical distributing organizations. It is believed that with this minimum training the immediate problem of timely and speedy inspection will be met without delay.

As soon as it is known that a suitable inspection system has been devised for a particular state, the Administrator advises all borrowers in that state that in order to protect their customers from the hazards of defective wiring, and for the protection of the borrower's organization, it is necessary that all wiring installations be inspected and approved by an accredited inspection agency before being connected to their lines.

We do not consider these steps which we have taken as adequate to meet the future national requirements of electrical inspection. Far from it. We are attempting temporarily to fill a need and an obligation.

GROUP BIDDING ON PLUMBING INSTALLATIONS FOR ELECTRIC WATER SYSTEMS

Under the Act, REA is also permitted to make loans for plumbing installations. In trying to make such loans and in trying to get water systems installed on any considerable number of farms connected to REA financed lines, we found the problems of standardization for mass installation to be even more perplexing than the wiring problem. Most of the wiring specifications could be written by stating that they shall be in accordance with the National Electric Code. With no such nationally accepted code to refer to in the installation of water systems and plumbing, the specifications had to be in detail. We feel that our plumbing engineer has worked out a set of specifications in which all of you will be interested.

The first group bidding project on plumbing has just recently been developed in connection with the Caldwell, North Carolina, project. The survey of this project showed quite an active interest in the plumbing program because of the success experienced with the group wiring plan. As a result, a survey was made and a proposal submitted to contractors. Under the group bid made on this project, I am told that the plumbing installations will be installed at a lower cost than the actual cost of materials alone, of like kind and quality, if bought by the customers individually at the best price quotations available to them from any source. An interesting feature of this particular effort was the expressed desire of farmers who have had electric service for years from an existing utility, but had never installed water systems, to be included in this group plan.

Field units which we now have in various regions, developing a utilization program on REA projects, are carrying on their work substantially as it has been outlined previously. Copies of both our wiring and plumbing specifications, and procedures for securing group bids are available for distribution. Members of the A.S.A.E. are urged to secure copies of these specifications and procedures, and to study them. We will welcome any suggestions for their further improvement which members of the Society may have to offer.

Dusting for Control of Citrus Pests

By Orval C. French

SEVERAL developments in recent years have stimulated interest in dusting for pest control in the citrus industry of California. Ten years ago it was found that sulfur dust was an effective control of citrus thrips. As a result, dusting has practically replaced spraying for this pest. Where dusts are effective the cost of control is considerably less than spraying.

Citrus red spider has been causing a great deal of trouble in many of the citrus areas of Southern California. Sulfur and sulfur compounds were the earliest materials used for red spider on citrus and are still used to some extent. Oil sprays, as well as selocide, have also been used. However, the use of selocide has been seriously questioned from the residue standpoint and oil sprays evidently have certain undesirable features with respect to the general health of the citrus tree, together with adverse effects on the fruit. Recently some new toxic organic materials have been developed which offer a great deal of promise for the control of citrus red spider. This development has demanded an improved type of duster because the requirements for applying dry materials for red spider differ considerably from those for thrips control. Thrips populations occur largely on the outer part of the tree, on the new growth, so that sulfur dust can drift into and on trees and still effectively control the insects. This is not the case with red spider. The dust must cover all surfaces of the foliage and fruits on the tree, both inside and out. This type of coverage calls for a large and efficient duster.

There are two important advantages of dusting as compared to spraying: (1) It is much faster, and (2) it is considerably less costly. If dusting can be made as effective as spraying, and at the same time less costly, then it will be a real contribution to the citrus industry.

The present dusters now in use vary from small factory-built units, with one or two hand-operated nozzles, to large fans driven with automobile engines, discharging the dust stream through two fishtail spreaders, each having a vertical spread of 4 to 5 ft. The latter type have all been constructed by or for individual growers, and it has been largely through their perseverance and convictions that the dusting program has progressed. Most of these machines will discharge a big cloud of dust, but in most cases it is not effectively blown into the tree.

During the past three or four years, there has been a decided trend toward the use of multivane fans in order to obtain large volumes of air with reasonable power requirements. All of the dusters formerly used pressure or exhauster-type fans, presumably because that is the type of fan used on manufactured dusters. It is impossible to obtain adequate coverage with the small volume fans, that is, if reasonable speed of dusting is maintained.

Two years ago the entomology division of the University of California at Riverside requested the agricultural engineering division to aid them in developing equipment with which they could apply experimental insecticides in the field in order to find a control for some of the citrus pests.

It was their opinion that it would be necessary to have a combination duster that would apply dust underneath and up through the tree, as well as on the outer foliage. Practically no information was available as to the amount of air or velocity required for dusting work. Observations of several of the better dusters with fishtail nozzles led us to believe that we might get better results with a combination duster having a nozzle that would float on the ground under the tree and discharge in a vertical direction, and another, hand-operated nozzle that would give a coverage of dust to the exterior of the tree. With this as a basis, we selected a No. 3 Master multivane, forward-curved-vane-rotor, single-inlet fan. For experimental purposes, and to reduce costs, the unit was designed to treat only one side of a tree row at one time. A Model A Ford with factory reconditioned engine was selected to drive the fan. The car frame was cut off just back of the universal joint and front wheels and axle removed. This left an

Presented before a meeting of the Pacific Coast Section of the American Society of Agricultural Engineers at Davis, Calif., January 8, 1938.

Author: Instructor in agricultural engineering and junior agricultural engineer in the experiment station, University of California. Mem. ASAE.

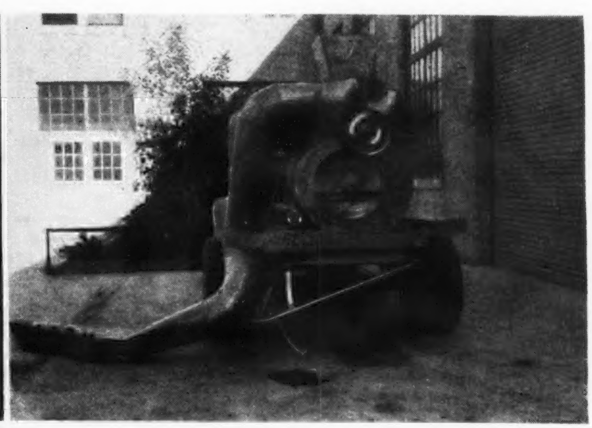


FIG. 1 (LEFT) AND FIG. 2 (RIGHT) TWO VIEWS OF THE EXPERIMENTAL CITRUS DUSTER WITH UNDERTREE NOZZLE AND HAND OPERATED CANVAS NOZZLE. ROTATING BRUSH TYPE DUST FEED

engine that was mounted complete with clutch, electrical and starting equipment, radiator and fuel tank. This engine was directly connected to the fan through a flexible coupling. The duster unit was designed to run at 1200 rpm, and at this speed would discharge approximately 10,000 cu ft of air per minute.

The engine and fan were mounted on a 4-in channel iron frame in order that the entire equipment could be removed from the truck as a unit. A V-type hopper was constructed with a 6x16-in cylindrical palmetto-fiber brush located in the bottom. Directly under the brush and fastened to the bottom of the hopper, was a sheet metal plate with a series of 3/4-in holes. The brush carried the dust around and between bristles and rubbed it through the holes where it fell in a trough leading to the intake of the fan. A false bottom with holes matching those in the stationary plate under the brush provided a means of closing off a portion of the feed holes, thus regulating the amount of dust delivered by the brush. This type of feed was believed necessary because the dust material was fairly sticky, having 20 per cent by weight of oil mixed with it. The fan casing was set so it discharged vertically. An adapter bonnet was placed over the discharge to turn the air at right angles and also divided the air into two ducts. One duct led to a hand-operated, 7½-in diameter canvas nozzle, the other to the underneath nozzle.

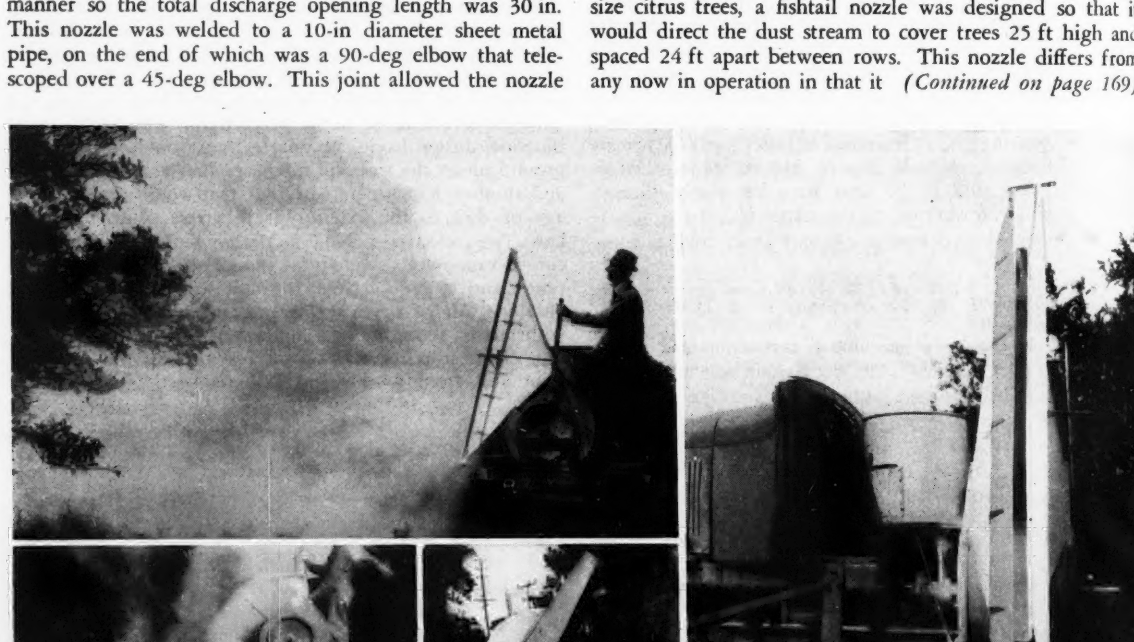
The underneath nozzle consisted of a box with five rectangular outlets each 2x6 in in cross section at the discharge opening. These outlets were staggered in an echelon manner so the total discharge opening length was 30 in. This nozzle was welded to a 10-in diameter sheet metal pipe, on the end of which was a 90-deg elbow that telescoped over a 45-deg elbow. This joint allowed the nozzle and supporting pipe to float along the ground and also to be turned around and back of the truck for transportation.

This equipment (Figs. 1 and 2) was used during the fall of 1936 and considerable information was obtained as to the efficiency of the duster, as well as to changes that would be necessary to accomplish satisfactory dusting. The hand-operated canvas nozzle was not entirely satisfactory because on large trees there was too much chance of the operator failing to cover all of the outer tree surface. The field tests indicated that the undertree nozzle should have the discharge band of dust increased from 30 to 60 in before the skirts of the trees could be properly covered. The results of these experiments also proved that it was not necessary to add oil to the dust mixture, so this factor eliminated the trouble in metering the dust into the fan. Ordinary sulfur feed hoppers would handle the dusts without oil very well.

In view of the encouraging results during the 1936 season, changes were made on the duster unit early this year, which was believed would overcome the defects of the duster as used last year.

Previous work indicated that a fishtail nozzle is desirable for outside coverage if some flexibility is provided. Objections to most of the present commercially operated dusters with fishtail nozzles are that they fail to have a wide enough spread, and thus miss the skirts and tops of large trees. Furthermore, they are stationary and discharge the dust in one fixed direction.

After taking many measurements of average and large size citrus trees, a fishtail nozzle was designed so that it would direct the dust stream to cover trees 25 ft high and spaced 24 ft apart between rows. This nozzle differs from any now in operation in that it *(Continued on page 169)*



EXPERIMENTAL CITRUS DUSTER

Fig. 3 (Upper Left) and Fig. 4 (Right) Improved type experimental citrus duster using a large fishtail nozzle with hinged deflectors. Fig. 3 shows duster in operation. Fig. 4 shows deflectors in extreme position to deflect dust stream back toward a tree. Fig. 5 (Lower Left) Experimental undertree dusting nozzle in operation. Fig. 6 (Lower Center) Undertree nozzle rotated for turning or transportation

Relationship Between Engineering and Agronomic Practices in Soil and Moisture Conservation

By Quincy C. Ayres

IT WOULD be hard indeed to imagine a more intimate relationship than that existing between engineering and agronomic practices in the field of soil and moisture conservation. Artificial control of water on much of our best agricultural land, whether by drainage (including overflow protection), irrigation, or velocity retardation, is a prime necessity before the agronomist can hope to begin successful operations. On the other hand, the engineer is dependent upon the agronomist for preknowledge concerning the kind of crops to be grown, moisture requirements of each, physical and biochemical properties of the soil, rotation plans to be followed, and similar information before he is in a position to undertake intelligent design.

Engineers and agronomists differ widely in background and training, in their stores of specialized knowledge, in habitual thought processes, and in methods of approach to a problem. Each has a distinct and vital contribution to offer and the success of any venture, in the long run, depends upon cordial and coequal cooperation. Every phase of soil and moisture conservation bears abundant evidence of the interdependence between engineering and agronomy, and it is the purpose of this paper to call attention to some of the more obvious relationships.

Drainage. There is no need to review the impressive statistics on drainage nor go into details concerning the engineering operations involved. These are well known and understood by agricultural engineers. Suffice it to say that much of the best land in the United States today is land that has been made productive by drainage. There is no denying, however, that a certain amount of odium is now attached to drainage operations in the minds of many laymen. This odium is due almost entirely to overemphasis on drainage failures. The failures, in turn, are ascribable, in some degree at least, to errors in judgment by overzealous, old-line engineers who were in charge of the projects, and who gave insufficient attention to the agronomic features involved when weighing costs against estimated benefits.

PREPARING NEWLY DRAINED LAND FOR CROP PRODUCTION

Not all newly drained land is immediately and automatically available for growing cash crops. Much of it requires an intermediate stage of development through the application of agronomic practices. This may be illustrated very well by the following paragraphs which have been adapted from a recent radio address by H. D. Hughes, agronomist of Iowa State College, on the subject, "The Handling and Cropping of Newly Drained Soils":

Such land is likely to consist in large part of peat, muck, or marsh-border soil, with any degree of gradation between these. Peat is partly decomposed vegetable matter which, without drainage, is preserved under water in a pickled condition. With drainage, any acids which may be present are leached out, oxygen and bacteria come in, and decomposition gets under way, the peat being changed into finely divided black material known as muck.

On soil that has been covered with water very little sod may have been formed, but on much of the marsh land to be cropped, a heavy sod must first be disposed of. With a tough, heavy sod, the first plowing is shallow in order to turn the sod completely for maximum exposure, but on unsodded peat deep plowing is practiced, especially if the peat is shallow, in order to mix in some of the subsoil and thus improve its physical condition and fertility. Marsh soils in which there is no heavy sod, or after this sod has been broken down, are quite mellow and loose and will generally require packing and firming with a heavy land roller in order to prepare a satisfactory seedbed. At least two years are required to subdue heavily sodded marsh land from the time it is first broken.

Newly drained soils are usually high in lime content, and contain an abundance of organic matter and nitrogen. Nevertheless, the application of small amounts of manure is helpful in introducing microorganisms essential to hasten satisfactory decay. Superphosphate, either alone or in combination with muriate of potash, has been found quite beneficial in some instances as an auxiliary fertilizer.

Buckwheat is a favorite first crop on peat, not only because it assists in sod decomposition, but also because the best yields of grain follow very late seeding. In addition, damage from worms, likely to be present in large numbers, is mitigated by late seeding and by the fact that the crop is drilled or broadcast. Hungarian or common millet, oats for hay, soybeans, rape, and flax are other recommended crops, although flax is preferred as a follow crop and is not considered desirable for pioneering. Seeding loose soils to timothy and alsike clover and pasturing the first year is considered excellent practice.

The foregoing deals primarily with the treatment of waste land in process of being converted by drainage into soils almost indescribably fertile and productive. Another prime function of drainage is to assure better control of ground water on lands already being cropped, by installation of underdrains at such depth and spacing as to best fit a particular set of soil and crop conditions. Really thorough and adequate drainage holds the water table practically constant at optimum depth, and thus insures greatly increased yields of better quality crops at the same acre-cost of production.

Irrigation. Although differing radically in details, what has just been said about drainage applies equally well in the field of irrigation. Failure by old-line engineers to take into account certain agronomic and economic facts, in the two decades from 1902 to 1922, caused a major upheaval in federal irrigation policy, and all but wrecked one of the finest aggregations of top-grade engineering technicians this country has ever seen. Utmost competence in applying the laws of hydraulics and in structural design is without avail, if cropping possibilities or any special agronomic difficulties do not justify the cost of supplying water.

Presented before the Soil and Water Conservation Division at the fall meeting of the American Society of Agricultural Engineers at Chicago, Ill., December 2, 1937.

Author: Associate professor of agricultural engineering, Iowa State College. Mem. ASAE.

If predictions of probable markets appear reasonably sound, irrigation developments usually divide into five classes of operation: (1) Dependable supply of water, which must be adequate in quantity and satisfactory in quality, whether the source be from wells, lakes, flowing streams, or reservoirs; (2) conveyance to irrigable land, which may vary from a few simple structures and short surface ditches to an elaborate and costly system of canals, flumes, tunnels, pipes, superpassages, culverts, siphons, massive check and turnout gates, warped-surface transition structures, and accurate measuring devices; (3) preparation of the land, which involves the removal of native vegetation, grading and smoothing the surface, and construction of head ditches, laterals, corrugations, borders, banks, and crosschecks; (4) measurement, control, distribution, and application of the water in such quantities and rates as to conform to optimum soil and crop requirements, whether the method be by surface flooding, or by the use of underground pipes with or without risers, overhead pipes (or flex-jointed, portable surface pipes) with nozzles, or by allowing the water to ooze through porous hose, and (5) maintenance provisions to insure continuity of operation and, in the West, to prevent alkali accumulation as the soil is transformed from arid to semihumid characteristics.

Inasmuch as the area of potentially arable land in the West vastly exceeds the amount of water available, even if every drop were conserved and utilized with ideal efficiency, irrigation progress will depend upon elimination of present wasteful practices and better adaptation of available water to moisture-holding and transmitting properties of the soil. Such things as amounts and rates of application, time and frequency of applications, and methods as related to crop needs and soil possibilities determine the efficiency and economy with which water is used. Great possibilities for improvement are apparent, and moisture conservation in irrigation is preeminently a job to challenge the combined resources of both engineers and agronomists.

Erosion Control. Important as are joint activities in drainage and irrigation, it must be admitted that the most popular opportunities for immediate service lie in the field of erosion control. While fundamental principles are much the same, their mass application to this new challenge has come with such explosive suddenness as to produce a state of bewildered confusion from which we are only now beginning to emerge. Truly scientific answers to many questions must await the results of additional years of experimentation and research, but meanwhile the problem is shaping itself in such form as to present clear features.

AGRONOMIC CONSIDERATIONS IN TERRACE DESIGN

Take terrace design for example. Terracing has withstood the test of time and has become established as a valuable, if not essential, support for sloping-ground agriculture, but we need more flexibility and better coordination of principles to get away from rule-of-thumb practices. Failures have been in almost direct proportion to the degree of carelessness and ignorance exercised in terrace design and construction.

Instead of assuming that steepness of slope is the only major variable affecting terrace spacing, should we not give more recognition to fundamental differences in soil behavior at times in the cropping cycle when the surface is bare and wholly unprotected by any kind of vegetation? It is inevitable that such periods must occur in any rotation plan. At such times the inherent resistance to dislodgment of individual soil particles is of vital significance, and this property has been shown to be dependent upon only three simple and easily determinable characteristics, namely, dispersivity, moisture equivalent, and colloid content. On all soils where porosity of texture and friability of structure, under the best cropping practices, are insufficient to absorb all rain as fast as it falls, surface runoff is bound to follow and the amount of the ensuing soil loss is a direct function of the three simple characteristics just mentioned. Why do agronomists not give more attention to this vital matter, and work out practicable techniques for field testing? Can it be that they regard it in the same category as soil testing to determine supporting power for highway pavement slabs and foundations, where engineers have worked out their own techniques?

RATIONALIZING TERRACE DESIGN PROCEDURE

Certainly a vast amount of work needs to be done by somebody to put terrace design procedure on a more rational basis and to reduce the large "factor of ignorance" which must at present be applied. As I see it, the well-known formula, $Q = CIA$, should come into more general use as a means of determining the required capacity of terrace channels under any given set of conditions. The drainage area, A, is a direct function of terrace spacing, which should be the maximum permissible on any given slope for a soil of known inherent resistance. The coefficient of imperviousness, C, is largely fixed by soil infiltration properties in the various profile horizons, which can be identified approximately from a knowledge of texture and structure, together with the cropping system practiced. There remains only to estimate the time of concentration at the outlet of each terrace and pick off the rainfall intensity corresponding to any desired frequency period from the charts in USDA Miscellaneous Publication No. 204, to make a complete solution possible. Knowing the critical runoff, the grade and cross section of the channel can be adjusted to yield the required capacity by use of the Manning velocity formula and of the relationship, $Q = aV$.

Once terrace design is established on a rational basis, the proper frequency period to select will need to come in for more detailed attention. The theory is, of course, that an economic balance should be reached whereby the damage resulting from failure at periodic intervals is less than the cost of providing additional protection. It seems to me that this may be the key to explain wide differences of opinion now held by engineers whose conditions of practice vary. The type of farming prevailing, kind of implements and power units used, and the general intelligence of the farm operator will have a large bearing on the frequency period selected and on the consequent capacity provided. The point here is that the chances of closer agreement in ideals and practices will be greatly enhanced if we start comparing quantitatively in terms of fundamentals, instead of continuing to argue over such things as spacings, lengths, grades, and cross sections.

Use of Vegetation. No line of activity illustrates the need for cooperation between specialists better than the use of vegetation as an important aid in control of erosion. It is the function of agronomists, ecologists, and others to determine the growth characteristics of various plants, their zones of natural habitat, soil and moisture requirements, hardiness, et cetera, but it is up to the engineer to evaluate quantitatively the values of the several species and to determine their limits of adaptability as engineering materials of construction. This means that a body of experimental data must be built up such as that now in existence for burnt clay products, concrete, masonry, wood, and various bituminous materials. It may not be necessary to go to the refinement of determining fiber stresses, moduli of elasticity, moments of inertia, and other similar properties, but the principle is the same, even though one group is immobile and inert, whereas the other is alive, growing, and

capable of self-propagation. Certainly such things as durability, dependability, behavior under water loading, conditions needed for satisfactory growth, and time required for establishment, should be matters of engineering record. These data will not only enable decisions to be reached regarding the need for supporting mechanical structures but will also permit cost comparisons in relation to surrounding land values and thus make it possible for the engineer to perform his true function of "doing the job as well as it needs to be done for the least cost consistent with that end."

Vegetal cover as an engineering material of construction has wide application for such purposes as gully restoration and control, stream bank protection, terrace and outlet channel stabilization, filter strips in cultivated fields and above diversion ditches, and others. The particular grasses and vines that are proving themselves best adapted for these purposes in various parts of the country are admirably discussed by T. B. Chambers in the September 1937 issue of "Soil Conservation" (vol. III, no. 3). This article is a good example of the kind of erosion engineering literature now being built up and that is so badly needed.

It goes without saying that the engineer should command thorough familiarity with mechanics, hydraulics, and structural design, as well as with properties of materials, in order to take full advantage of vegetal aids and adapt them most advantageously to his purposes. In addition he will be able to suggest many helpful practices such as plowing and cultivating on the contour, contour furrowing of pastures and orchards, and use of explosives in opening tight subsoils, and flattening gully banks. Among the mechanical devices already in use are pocket and basin forming machines, deep chisel cutters, sod strippers, and contour furrowers, not to mention the several types of machines designed especially for terracing and other conservation earth-moving jobs.

This discussion could be carried on almost indefinitely, but enough has been said to bring into focus some of the numerous points of impact between the work of the soil and moisture conservation engineer and that of other specialists. What is needed all around is a spirit of willingness to cooperate for the common good by well-trained men of integrity and ability, of judgment and tact, of brains and heart. It is very easy to carry questions of technical prerogative to absurd extremes, as exemplified by an engineer being required to seek from a forester an "official" reply to the question, "What kind of a tree is that from which I just gathered this basket of walnuts?" And shall the engineer insist upon the right to execute or personally supervise each and every operation in connection with the simplest problem in land mensuration and mapping? There may be some excuse for sharp distinctions in the trade boundaries of labor unionists, but for those who aspire to recognition as intellectual professionals to quarrel and bicker over questions of petty jurisdiction is, to say the least, an unlovely spectacle. After all, the control of erosion on sloping, cultivated fields is normally a problem in hillside drainage, and its solution is clearly a direct engineering responsibility. Keeping productive soil in fit mechanical condition has long been recognized as a job for engineers whether the particular method of treatment be draining excess water from wet land, preventing overflow on flat land, removing obstacles from encumbered land (stones and stumps), applying water to dry land, or retarding runoff from steep land. All of these operations obviously branch from one and the same stem, namely, soil and moisture conservation. This plain and simple fact, because it is so plain and simple, is ultimately bound to prevail.

Dusting for Control of Citrus Pests

(Continued from page 166)

sets directly over the fan outlet. The area of the discharge opening of the fishtail is equal to that of the fan outlet. Another new feature, hinged deflectors, was added to the fishtail, which allowed the operator to control the horizontal direction of the dust stream. By means of a simple lever arrangement, the dust can be directed towards a tree while approaching it and likewise continue to direct the dust into the tree after leaving it. This flexibility also provides better coverage of undersides of leaves and backsides of fruits since, by slowly shifting the direction of discharge back and forth, the foliage and fruit is agitated or swayed about. For small trees the upper portion of the dust stream can be cut off with a hinged baffle; no other baffles or fins were used. The opening of the fishtail at the discharge side is 63 in long by 4 in wide. With a fan speed of 1200 rpm, approximately 10,000 cu ft of air per minute can be discharged at an average velocity of 65 mph (Figs. 3 and 4).

A new undertree nozzle (Figs. 5 and 6) was also built this past spring, using the same design as previously described, but having a discharge opening 60 in long instead of 30 in and a corresponding increase of duct size leading from the fan to the nozzle. Since the fan was not large enough to operate both the fishtail and the undertree nozzle at the same time, they were made interchangeable. With a fan speed of 1200 rpm approximately 7000 cu ft of air per minute can be discharged from the undertree nozzle at an average velocity of 65 mph. With these two attachments, it was possible to obtain very good tests on the effectiveness of application with either one alone, also with applications with both on the same plot.

The equipment has been used almost continuously throughout this season, having applied over 30 tons of material. While the results have not all been analyzed at this time, it appears that effective control has been obtained with the fishtail nozzle and that it is unlikely that an application need be made from underneath the tree. The addition of the movable deflectors on the fishtail nozzle appears to have improved the effectiveness of this type of distributor to the point where it will give adequate coverage for general citrus dusting.

This equipment has created a genuine desire, on the part of many growers, to build similar units. Obviously a commercial duster will require a fan unit having two fishtails in order that two rows can be dusted at one time. The fan should be large enough to supply at least 10,000 cu ft of air per minute through each fishtail. The velocity of air leaving the fishtail should not be less than 65 mph. The addition of the second fishtail nozzle entails considerably more difficulty in securing uniform distribution of both air and dust material within the air stream. Also it is a problem to keep the unit narrow and still secure great enough spread of the dust to cover large trees. These problems are not unsolvable, however, and it is believed a design now being attempted may meet the requirements. At the present time it appears likely that a dusting program with good equipment will control one of the important citrus pests, namely, red spider.

Author's Note: Since this paper was written a commercial two-row duster meeting the requirements outlined has been made available.

What Agricultural Engineers Are Doing

FROM THE U. S. BUREAU OF AGRICULTURAL ENGINEERING

TWO papers relating to work of the drainage camps were presented by the central district personnel at the annual meeting of the Iowa Engineering Society at Iowa City, March 9 and 10. These were "Drainage Camps in Iowa" by George Burnet, inspector of the Iowa camps, and "Pumping Plants for Drainage Districts" by H. E. Berger, superintendent of the Oakville camp.

* * *

Authorization for the establishment of two side camps for Ohio has been received within the last month. One has been established at Sand Beach in Ottawa County, as a side camp to the Bowling Green camp, to undertake needed maintenance on outlets to ditches rehabilitated in Wood County by the camp. A 38-man side camp to the London camp will be established at the abandoned Delaware camp on or about April 1, to finish work left uncompleted when the camp was abandoned in December.

* * *

Thaws and rain preceding the usual spring flood periods have resulted in the undertaking of requested emergency work by the Whiting, Iowa; Havana, Illinois; and Delta, Missouri camps during the last month. Due to high water in the St. Francis River, the Hayti camp has been prepared to provide immediate emergency aid if required.

* * *

A. A. Young and Harry F. Blaney completed the manuscript for a proposed bulletin entitled "Use of Water by Native Vegetation," embodying the results of studies made by the Division of Irrigation on consumptive use of water by a number of species of native vegetation, and reviewing some of the results of investigations on the subject by other agencies. Cooperating in the carrying on of experiments have been the California Division of Water Resources (Department of Public Works), and the Colorado and Oregon agricultural experiment stations.

* * *

The Division also conducted studies in the Upper Rio Grande Basin in cooperation with the states of Colorado, New Mexico, and Texas, under agreement with the National Resources Committee. Until recently little attention has been given to use of water by noncrop plants.

Experiments show that such plants as weeds, willows, cattails, and tules use from 50 to 100 per cent more water than most crop plants. However, the authors do not lose sight of the value of native vegetation in aiding the penetration of water into the soil, holding sandy soils in place against wind action, and combatting soil erosion.

* * *

For studying subsoil water behavior, Dean W. Bloodgood completed the installation of water-level recorders at representative locations on the reservation division of the Yuma Reclamation Project. At the present time there are nine such installations and one more is to be installed at a deep well between the All-American Canal and the present High Line Canal. The wells range from 16 to 40 inches in diameter and are equipped with 14 to 30-inch copper floats. The recorder wells are to be used in conjunction with about 160 other pipe observation test wells and staff gages in studying subsoil water behavior. Seven months' records have been obtained from most of these wells and about two years' records from 18 pipe wells and 5 recorder wells. By the time water is turned into the All-American Canal for priming purposes next July or August, about a year's record will be available for the entire reservation division.

* * *

R. L. Parshall reports that apparatus is being constructed at the Bellvue, Colo., hydraulic laboratory to investigate the distribution of negative pressures along the under side of the horizontal gate shelf of the adjustable tube orifice meter. The purpose of this study is to determine the possibility of developing a means of calculating the discharge through the meter without measuring directly the effective pressure heads.

* * *

In connection with the Spokane River Flood Control Report, L. T. Jessup compiled annual runoff data (in terms of inches depth) for a 45-year period; compiled a similar table with corrections for storage in Coeur d'Alene Lake; and made a capacity table for that lake. A study was made of the relation between stage of the lake and discharge of Spokane River at Spokane; and an estimate was made of the stage of Coeur d'Alene Lake for certain runoff data (depth in inches) from December 1 to June 15 for a 45-year period.

* * *

With reference to his study of irrigation problems in citrus orchards, Colin A. Taylor reports that all of the transpiration-use of water material was worked over and expressed as a ratio of the loss of water from the shallow black-pan evaporimeter. A ratio of 0.33 was established for the relation of transpiration by mature citrus to evaporation, for the eastern part of Los Angeles County. The average length of the irrigation season was established as 232 days, extending from April 9 to November 27. During this period the evaporation amounts to 55 inches. A range of 50 to 60 inches covers most seasons. On the average the equivalent of 18 inches of available moisture must be supplied as carry over from winter rains or by irrigation.

* * *

Monthly reports of snow cover conditions for the various watersheds of the western states, preparation of maps of snow courses and weekly radio broadcasts of winter sports conditions represent the chief activity of the snow survey project. J. C. Marr completed a map showing the Columbia River Basin snow course network, with all courses identified as to name and location, copies of which were to be sent out with the March 1 forecast report. R. L. Parshall sent out instructions, sketch maps, and record forms to forest supervisors who were to be concerned with the March 1 observations, and purchased additional snowshoes and skis which were sent to those who were to make the March 1 observations. Carl Rohwer made a study of the literature of snow surveying, devised forms for keeping the snow survey and streamflow records, mapped the drainage areas of Arizona, located gaging stations on the map, and compiled streamflow and snow survey records. L. T. Jessup made maps of seven new snow courses. M. R. Lewis held two conferences with the Oregon state engineer, at which a start was made toward the study of the correlation of snow survey data and runoff.

* * *

J. W. Randolph reports that the samples of cotton for the 1937 season from the cotton production machinery project at Prattville field were ginned at the Bureau's ginning laboratories under C. A. Bennett's supervision. The following points were found to be of pertinent interest regarding the first and second picking. There exists a direct relationship between yield of seed cotton and energy required for ginning, and motes and the apparent specific gravity of the soil. On the other hand, there is an inverse correlation between yield of seed cotton and motes. The correlation factors obtained indicated that chance accounted for less than one per cent of the relationship, which is exceptionally good. The correlation between the energy required to gin the cotton from the second picking and the yield was not so significant. It is of interest to note that relationships between motes and yield, and motes and apparent specific gravity indicate that there is an inverse relationship between yield and apparent specific gravity. This substantiates the data previously reported.

* * *

The worth of the variable-depth method of planting is now so well established that the John Deere *(Continued on page 182)*

Contributions Invited

All public service agencies (federal and state) dealing with agricultural engineering research and extension, are invited to contribute information on new developments in the field for publication under the above heading. It is desired that this feature shall give, from month to month, a concise yet complete picture of what agricultural engineers in the various public institutions are doing to advance this branch of applied science.—EDITOR.

Authors

James B. Kelley and Earl G. Welch are joint authors of parts 2 and 3 of Kentucky Extension Circular No. 304, entitled "Soil Erosion and Its Control," and of Kentucky Extension Circular No. 305, entitled "The Cost of Rural Electric Service."

Eugene G. McKibben is author of "Some Kinematic and Dynamic Studies of Rigid Transport Wheels for Agricultural Equipment," which has been published as Research Bulletin 231 of the Iowa Agricultural Experiment Station.

NEWS

SEEING AMERICA

Enroute to the A.S.A.E. Annual Meeting — June 27 to 30 — at Asilomar, Pacific Grove, California

By J. Dewey Long

IF YOU have decided to attend the A.S.A.E. annual meeting at Asilomar this summer and combine with it a summer vacation, you are probably already enjoying the anticipation of new scenic attractions, novel agricultural lands and practices, and strange people. If you have never traveled in the West before, perhaps the observations and experience of another agricultural engineer will be of interest.

Doubtless you have already been offered the facilities of the various public carrier systems. The railroads, particularly, offer several classes of transportation at corresponding costs which permit one to select the accommodations best suited to his requirements and pocket book. If you are driving the family automobile, it may interest you to know that one of the oil companies made a survey of automobile travel costs in the West last year. Their results, which approximate my experience, are that all daily costs, including food, lodging, automobile operation, and minor repairs, total less than 1⅞ cents per person-mile. Naturally, one must anticipate emergencies, but normal automobile travel costs are not excessive. The flexibility of such travel appeals strongly to many travelers.

If you do drive your own car, expect long stretches of road, hot and dry winds, and marvelous panoramas of desert and mountains. Settlements may appear only every hour or so, but gas stations and emergency garages occur every few miles. Road surfaces on the main highways will average well above ordinary, and the road hazards of the highways through desert and mountain are practically nil—unless the driver goes to sleep. Fellow travelers along the road are frequent, and considerate in rendering assistance to distressed parties. Excellent tourist camps providing hotel accommodations at an average cost of about 75 cents per individual for parties are to be found along the way, and the hotels of all classes are accustomed to tourists. Prepare to travel in comfort; wear comfortable sports clothing, let down your hair if you like—you're in the West, where a man is a man regardless of his appearance.

A popular circuit is to drive west by one of the southern or central highways (anticipating the hotter summer weather to follow), and return east by a more northern route. One can average 350 miles per day, and still have time for short stops at points of scenic or technical interest. Many stops will warrant spending a longer time, depending upon the individual's interest and nervous temperament. Much of the pleasure of such a trip is in discovery, but a few suggestions may not be amiss.

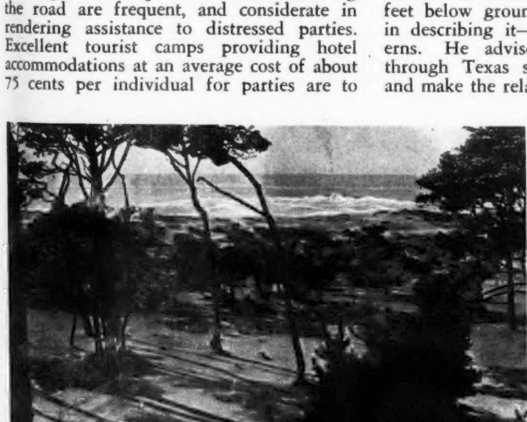
Each of the main highways has its historical background which will interpret and lend glamour to the sights along the way. Let your librarian suggest one or more books on the Santa Fe trail to the Southwest, the 49er trail to California, or the Oregon trail to the Northwest. The National Park Service has done splendid work in preserving and making accessible the natural and historic wonders of the region. Secure their booklet "Glimpses of our National Parks," and then the individual folders of the parks or national monuments which you shall wish to visit. The various state chambers of commerce or tourist bureaus also distribute much material of value to tourists.

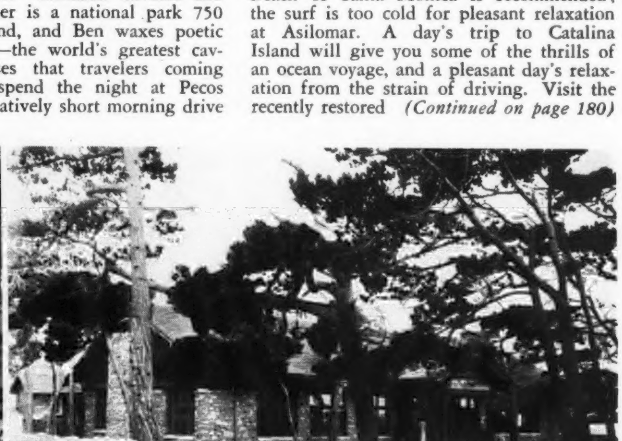
It is, of course, impossible for one person to advise another on scenic "musts." Ben Moses (a member of A.S.A.E.), a native of New Mexico, advises two outstanding spots in that state—Carlsbad Caverns and Taos. The former is a national park 750 feet below ground, and Ben waxes poetic in describing it—the world's greatest caverns. He advises that travelers coming through Texas spend the night at Pecos and make the relatively short morning drive for the midmorning trip underground. He states that the extra day which may be required for this side trip will not be expensive, and is one which will never be regretted. Santa Fe was the terminal for the early day traders, and as such has much of interest including the Palace of the Governors. Not far distant is Taos, now largely an artist colony, and about five miles from this center of civilization is the multi-storied Indian pueblo of adobe. Here life goes on much as it did three centuries ago, except that the "Officer of the Day" may address you in English and tell of his experiences in the show on the Chicago World's Fair Midway. On the byroads in this country one finds most interesting native villages.

Arizona has its Grand Canyon, but the Kaibab Forest and Zion and Bryce Canyon National Parks across the line in Utah are even more enjoyable to some visitors. Arizona has another attraction not less noteworthy in its class—the old Missions. Read Willa Cather's "Death Comes for the Archbishop." San Xavier del Bac six miles south of Tucson is recognized as the most nearly perfect type of architecture used during the Spanish regime. The prehistoric Casa Grande ruin north of there stirs deeper into one's imagination.

Across the Imperial Valley, into San Diego, and up the coast into Los Angeles makes a pleasant trip through unique agricultural areas, but most travelers take the more direct route through Needles.

In and around Los Angeles there is much to see—ask the All-Year Club of Southern California. The ocean bathing at Long Beach or Santa Monica is recommended; the surf is too cold for pleasant relaxation at Asilomar. A day's trip to Catalina Island will give you some of the thrills of an ocean voyage, and a pleasant day's relaxation from the strain of driving. Visit the recently restored *(Continued on page 180)*





(LEFT) VIEW FROM THE MAIN LOUNGE AT ASILOMAR . . . PINE TREES . . . SAND DUNES . . . OCEAN FRONT . . . THE PACIFIC OCEAN STARTS HERE. (RIGHT) SEA BREEZES WHET APPETITES TO MAKE THIS ASILOMAR'S MOST POPULAR SPOT — THE DINING HALL

"WE SOLD 52 TRACTORS"

"We have not sold one tractor for low-grade fuel yet," says H. E. May, Cletrac dealer of Alamosa, Colorado

WHEN a tractor dealer sells 52 tractors in 8 months, the natural question is: "How did he do it?" Let Mr. May, manager of The Romeo Stores Company, answer for himself:

"We know that our success is based on the sound foundation of a high compression tractor and good gasoline. We have not sold one tractor for low-grade fuel yet, and don't intend to, unless we are forced by the purchaser.

"Our five-county territory, which includes the San Luis Valley, lies at an elevation of 7,500 feet. The days are hot and the nights are cold. With a low-grade fuel it takes longer to warm a tractor up in the morning after a cool night. Furthermore, with low-grade fuel, there is so much crankcase dilution that it is necessary to add one to two quarts of oil every day. When the low-grade fuel goes by the rings, it washes the lubrication off the walls, making more wear and tear on the parts. With the high compression Cletrac we drain oil only every 60 hours.

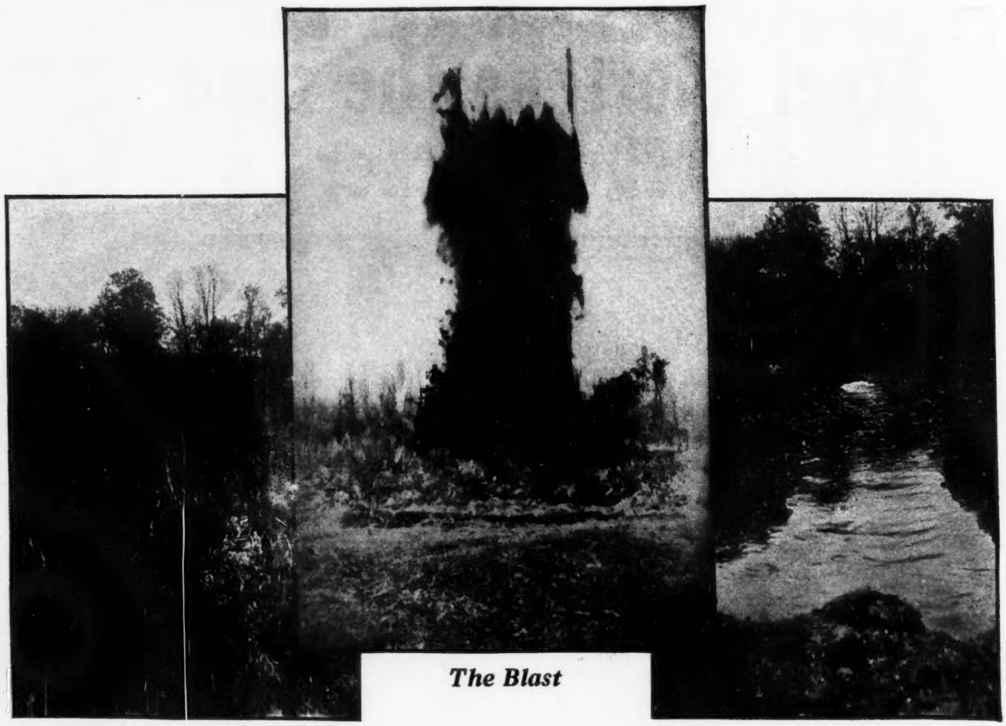
"Another reason we insist on good gasoline is that it is the only way we can compensate in the engine for loss of power due to altitude. By using gasoline as a fuel in a high compression Cletrac, we use 7,500-feet altitude heads to compensate for loss due to altitude."

Mr. May is right

A high compression tractor plus regular-grade gasoline is the winning profit combination for 1938. Make it bring you your share of tractor sales. You'll make those sales easier—and make more of them—when you talk, demonstrate and sell high compression. You'll have fewer service calls after the sale is made.

Write your manufacturer or blockman today for information about the latest high compression models, and also details of high compression ("altitude") pistons or cylinder heads to change over low compression tractors. And remember, a good tractor is a better tractor with regular-grade gasoline. Ethyl Gasoline Corporation, Chrysler Building, New York, N. Y., manufacturers of anti-knock fluids used by oil companies to improve gasolines.

TO SELL MORE TRACTORS
DEMONSTRATE HIGH COMPRESSION



Before the Blast *The Blast* *After the Blast*

Drain off the water from Spring freshets . . . quickly and economically with Atlas Explosives . . .

Atlas Farmex Ditching explosives provide portable power for quick action, favorable results and real economy! You need no expensive equipment. You'll save valuable time and plenty of effort!

You'll profit by the speedy effectiveness of Atlas Farmex Ditching explosives whenever you use them—and you'll particularly appreciate their value in emergency jobs where time gained means money saved.

Ditch blasting is easy with Atlas Farmex Ditching—and Atlas will suggest the correct methods for best results.

ATLAS POWDER COMPANY, WILMINGTON, DEL.

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Butte, Mont.	Kansas City, Mo.	New York, N. Y.	Portland, Oregon	St. Louis, Mo.
Chicago, Ill.	Knoxville, Tenn.	Philadelphia, Pa.	Salt Lake City, Utah	Tamaqua, Pa.
Denver, Colo.	Los Angeles, Calif.	Picher, Okla.	San Francisco, Calif.	Wilkes-Barre, Pa.

ATLAS

EXPLOSIVES

CHEMICALS ATLAS EXPLOSIVES

Less Scuffing and 12½¢ Less Cost

EVERYTHING IDENTICAL but the steel. *But the gears at the right made of a special grade of U·S·S Carilloy Alloy Steel—will scuff less, run more quietly, and cost 12½c less per set. A typical result of close cooperation between our metallurgists and yours.*

...both obtained with one change in Steel

TO make a cheaper set of gears is not difficult . . . if quality can be sacrificed.

To make a better set of gears is no greater problem . . . if cost can be ignored.

But to make a better *and* cheaper set of gears — gears which will run more quietly, scuff less and save 12½c per set in material cost — is an accomplishment of which any two metallurgists can well be proud.

This is the result of a cooperative study, extending over a six weeks period, by a metallurgist from Carnegie-Illinois and a metallurgist of a well-known automobile manufacturer. The first was thoroughly familiar with alloy steels and the limitless combinations of analyses and heat treatments. The second knew the requirements of their 1938 models and the advantages of their plant facilities. Working together, they could coordinate and pool their knowledge. They could achieve a result that neither could achieve alone.

Our aim is to give you outstanding metallurgical cooperation . . . and the finest alloy steels possible.

U·S·S CARILLOY ALLOY STEELS

CARNEGIE-ILLINOIS STEEL CORPORATION

Pittsburgh *Chicago*

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* — United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

SEEING AMERICA

(Continued from page 171)

Olivera Street exhibiting the early Spanish days in Los Angeles; it is worth doing even though you may have slipped over the line into Mexico at Juarez, Mexicali, or Tia Juana. If you do visit any of these border towns, watch out for your interests in any financial transactions. The movie stages of Hollywood have been closed to the casual visitor since the advent of sound pictures, but of course you may have a distant cousin connected with the industry. Take the Coast Route north to San Luis Obispo, and then turn inland over "El Camino Real," unless you would prefer driving the high bluffs above the ocean and constant hairpin turns of the newly opened road past Hearst's San Simeon ranch and through the Santa Lucia Mountains.

From Asilomar one can drive north through interesting country to San Francisco with its two new bridges, the Embarcadero attractive with foreign shipping, the fishing fleet at Fishermans Wharf, the Golden Gate park, the wrecked ships at Land's End, Chinatown, the panorama from Twin Peaks, and the foreign restaurants to delight epicureans.

Across the San Joaquin Valley to the east about 5 hours driving time are Yosemite and the Sequoia National Parks. North of them are the Mother Lode Country of the gold rush, Sacramento, Lake Tahoe and the highway east through Nevada's wide spaces. Utah's salt flats, great Salt Lake, and Mormon Square in Salt Lake City lie on this road. The noon organ concert in the Mormon Tabernacle is worth waiting several hours to hear. Further on one may wish to turn off the road to visit the Grand Teton and Yellowstone National Parks.

Going north from San Francisco one follows the famous Redwood Highway through awe-inspiring stands of the giant trees. The groves here are more striking than those near the Monterey Bay site of Asilomar, and the Pacific Lumber Company sawmill at Scotia will prove a fascinating stop. If one is interested in geology the geysers at Calistoga just north of San Francisco and the Lassen Volcanic National Park on north of Sacramento are worth including. The geysers are admittedly second rate compared to those of Yellowstone, but Lassen is unique. Near Lassen is the Red River Lumber Company mill where fir logs almost as large as small Redwood are put through the saws or turned into plywood paneling.

Continuing north from the Redwood Highway one enters Oregon's Roosevelt Highway along the coast. If one should tire of the ocean scenery, it is possible to turn inland to the road continuing north from the Sacramento Valley, drive through the Rogue River apple country, the flower bulb growing country about Medford, visit Crater Lake and continue on into Portland. The famous Columbia River highway and the Bonneville Dam are worthwhile side trips.

Across the Columbia River in Washington is Longview, the model industrial town conceived by the Long-Bell Lumber Company. The lumber industries here are deserving of the agricultural engineers attention. The Olympic Peninsula across from Seattle is known as the last stronghold of virgin country. Vancouver Island, a nice ferry trip from Seattle, and the city of Vancouver on the mainland give one a taste of foreign life as it might be lived in England. To the east of Seattle one finds Grand Coulee, the Palouse hills where one marvels at the wheat combines operating around steep hills, the triangular tour through Glacier and across the line into Banff National Parks, and thence south through Yellowstone and to the main highways east. The Black Hills and Bad Lands areas are attractive in their way, but would probably be an anticlimax.

ASAE Officers for 1938-39

As a result of the annual election of officers of the American Society of Agricultural Engineers just held, the new officers elected to take office following the annual meeting of the Society to be held at Asilomar, Pacific Grove, California, June 27 to 30, are as follows:

President, Samuel P. Lyle, senior agricultural engineer and extension specialist, Bureau of Agricultural Engineering, U. S. Department of Agriculture.

Vice-President (one-year term), E. E. Brackett, professor of agricultural engineering (head of the department), University of Nebraska.

Vice-President (two-year term), G. A. Rietz, in charge of rural electrification, General Electric Company.

Vice-President (three-year term), F. P. Hanson, manager, merchandise bureau, Caterpillar Tractor Company.

Councilor, J. C. Wooley, professor of agricultural engineering (head of the department), University of Missouri.

The new Council of the Society for the year 1938-39 will include the above-named officers, together with H. B. Walker and C. E. Ramser, councilors, and R. U. Blasingame and A. P. Yerkes, senior and junior past-presidents, respectively.

The newly elected Nominating Committee of the Society consists of L. F. Livingston (chairman), E. G. McKibben, and G. W. Kable.

New Appointment at Wisconsin

F. W. DUFFEE, head of the agricultural engineering department, University of Wisconsin, announces the appointment of Max J. La Rock as extension agricultural engineer in farm structures to succeed S. A. Witzel, who is taking the place of the late E. R. Jones in resident teaching and research. Mr. La Rock is a graduate architectural engineer, with several years' experience as a professional architect and rural carpenter and contractor, and with four years' experience as research architectual engineer with the U. S. Bureau of Agricultural Engineering.

Farm Structures Conference Held at Minnesota

A FARM Structures Conference was held March 4 by the division of agricultural engineering, University of Minnesota, for farm building interests of the State.

H. B. White served as chairman of the conference. Other ASAE members contributing to the program included William Boss, C. T. Bridgman, Don Critchfield, C. H. Christopherson, J. G. Dent, A. Hustrulid, P. W. Manson, D. G. Miller, and A. G. Tyler. Economics of farm building, materials, electrification, construction, equipment, and building information services were featured on the program.

Duffee Heads Electric Fence Group

F. W. DUFFEE, head of the agricultural engineering department at the University of Wisconsin—and this year chairman of the A.S.A.E. Power and Machinery Division—has been selected chairman of a special technical subcommittee on electric fences that has been set up under the National Electric Safety Code. This sub-committee has a membership of twelve, including the outstanding men in the United States studying the subject of electric shock, among whom are representatives of Edison Electric Institute, Bell laboratories, Underwriters' Laboratories, U.S.D.A. Bureau of Animal Husbandry, electric utility companies, and several universities. The committee will hold its first meeting at New York City about the middle of April, and it is expected that it will shortly thereafter issue a report which is to be included in the National Electric Safety Code.

McMillen Vice-President of Chemical Foundation

WHEELER McMILLEN, president of National Farm Chemurgic Council and editorial director of "The Country Home," has been elected a director and vice-president of The Chemical Foundation, Inc.

Mr. McMillen succeeds the late Francis P. Garvan as a director of The Chemical Foundation. In assuming the vice-presidency, Mr. McMillen becomes the ranking officer of the Foundation, since no immediate successor is proposed for the office of president which was held by Mr. Garvan, who, during the 18 years he directed the Foundation, played a major role in the development of the American chemical industry and the chemurgic movement.

The Chemical Foundation will continue its support of research development in the chemical, scientific, and medical fields, according to William W. Buffum, treasurer and general manager. Particular emphasis will be placed upon activities tending toward establishment of new chemurgic industries through the use of farm products as industrial raw materials.

ASTM Issues Tentative Specifications on Fencing

TENTATIVE specifications for zinc-coated (galvanized) iron or steel farm field and railroad right-of-way wire fencing have been issued by the American Society of Testing Materials as a tentative revision of the corresponding standard in its 1936 book of standards. It applies to both woven and barbed wire fencing.

Committee A-5 on corrosion of iron and steel considers the tentative specifications a definite step forward inasmuch as the specifications cover a number of different qualities. This is said to represent the first effort in the direction of standardizing upon more than one quality in order that the consumer might obtain a quality of coating which would be most economical under the specific conditions of service it might be necessary to meet.

The A.S.T.M. states that it is particularly interested in receiving comments from members of the A.S.A.E. in respect to these tentative specifications, and offers to furnish copies on request.

(News continued on page 182)

Announce SAE Tractor Meeting in Milwaukee

TRACTOR design and manufacture for longer life, higher efficiency, and greater economy are to be featured in a two-day meeting of the Society of Automotive Engineers, at the Schroeder Hotel in Milwaukee April 14 and 15.

A "Transmission and Axle Session" will open the program the morning of April 14. E. G. Boden, experimental engineer, Timken Roller Bearing Company, will present a paper on "Deflection Tests on Transmissions and Axles," which will be discussed by seven other engineers. The tests on which Mr. Boden will report are said to indicate an important relationship between shaft stiffness and gear tooth loads; and to suggest possible redesign for lower cost and higher load capacity.

A trip through the Allis-Chalmers Tractor Plant is scheduled for the afternoon of April 14. It will include an inspection of assembly of the new Model B small tractor. "Open House Evening," the same day, has been scheduled to provide opportunity for individual contacts and sociability as desired.

The Milwaukee plant of the International Harvester Company will be inspected the morning of April 15. This trip will feature observation of the manufacture of diesel engines, injection equipment, and tractors.

Ways and means of designing longer life into tractor engines will be the object of a "Symposium on Engine Wear" scheduled for the afternoon of April 15. Contributions planned will deal with "Valves and Valve Gears," "Shop Practice," "Lubrication," "Piston Rings and Cylinders," "Spark Plugs," "Dust House Testing," and "Hardened Crankshafts and Cylinders."

At the "Annual Tractor Dinner," the evening of April 15, the feature address, "New Frontiers for Smart People," will be made by Dr. James S. Thomas, president of Chrysler Engineering Institute.

The meeting is sponsored by the tractor and industrial power equipment activity committee of the SAE, with the cooperation of the Milwaukee Section, SAE. George Krieger (Mem. A.S.A.E.), agricultural engineer, Ethyl Gasoline Corporation, is general chairman of the meeting. A.S.A.E. members are invited to attend.

What Agricultural Engineers Are Doing

(Continued from page 170)

Company carries a variable-depth planter as a regular stock implement for the trade.

* * *

S. W. McBirney reports the multiple-row, single-seed sugar beet planter is being completed and will be ready for use to put in a series of plots as soon as the weather settles and the ground is ready for planting.

* * *

L. G. Schoenleber took a special grain drill to eastern Maryland on March 14, for the purpose of conducting fertilizer-placement experiments with cannery peas. One of the main objectives is to determine the effect of method of fertilizer application on the size and quality of the peas.

* * *

W. H. Redit left Washington on March 18 in connection with the planting operations of the fertilizer placement studies with cotton and tobacco in several southeastern states. His first stop is Tifton, Ga.

Washington News Letter

from AMERICAN ENGINEERING COUNCIL

THE AEC Bulletin is designed to provide member societies with intimate knowledge of public affairs and information regarding fields of activity not covered by other engineering organizations. Since copies can not be sent to all members of member societies, it is hoped that the representative or representatives on Council will bring the contents of each issue to the attention of their boards of direction, lay it before interested committees and make it known, as much as possible, to their membership as a whole.

The resulting opinion of member societies regarding the activities of the American Engineering Council, if expressed to the Assembly and Executive Committee through headquarters, will be summarized by the staff and, when officially approved, used to indicate the judgment or attitude of the organization of engineering organizations concerning matters of interest to the engineering profession and problems in the public welfare. Such expressions of considered engineering opinion from all affiliated bodies are solicited by Council's officers as a basis for the formulation of policies, and for staff guidance in expressing engineering attitude on major issues. In cases where it is not practical to try to express the prevailing opinion of the membership, it will be helpful to know the attitude of your board of direction and your representative or representatives on Council's Assembly.

NON-TECHNICAL PHASES OF ENGINEERING

American Engineering Council is deeply interested in the many contributions being made by the Engineers' Council for Professional Development and takes pleasure in making the following comment on the fifth annual report of that body available to the readers of the AEC Bulletin. The report, which carries a list of the accredited engineering schools of the United States is available for distribution and may be obtained from Mr. A. B. Parsons, secretary, Engineers' Council for Professional Development, 29 West 39th Street, New York, N. Y.

"Noting the trend in the extension of engineering far afield from old-time technical confines, Charles F. Scott, chairman of the Engineers' Council for Professional Development, in the fifth annual report of that body, available for public distribution, predicts a future which will call more and more upon the engineer for aid in solving its accumulating nontechnical problems. Traditionally technical through the centuries, the engineer has been slow in assuming this new role. Accustomed to dealing with definite data and rigid physical laws, the less definite situations in economic and social relations do not appeal to the majority of present-day engineers.

"The real contribution of engineering to nontechnical fields is the 'engineering method' of scientific approach for the solution of economic and social problems. Furthermore, the public does not understand the significance of technological changes in producing the more abundant life, nor does it appreciate that the achievements of the engineer are products of a scientific method, which may result in achievements in other fields as well.

"It is felt that the work of better acquainting the young engineer with the nontechnical phases of engineering may well be given emphasis by the Engineers' Council for Professional Development.

"Developing a system whereby the progress of the young engineer toward professional standing can be recognized by the public, by the profession, and by the man himself, the Council, through standing committees on student selection and guidance, accrediting (approval) of engineering curricula, professional training, and professional recognition, aims to coordinate and promote efforts and aspirations directed toward higher professional standards of education and practice, greater solidarity of the profession, and greater effectiveness in dealing with technical, social, and economic problems.

"Since the accrediting program was inaugurated in 1935, a total of 134 degree-granting engineering schools have submitted 645 curricula for accrediting. Of this number, 129 institutions have been visited to date and recommendations prepared on 626 curricula, as follows: To accredit, 374; to accredit provisionally for a limited period, 71; to defer action, 8; and not to accredit, 173. At present there is every indication that the accrediting program will result not only in a generally accepted accredited list, for which there is a real need, but also in a definite stimulation to higher excellence in our engineering schools, and a wide distribution among the institutions, particularly among officers of administration, of some of the best ideas in engineering education.

"The crux of the entire program of professional training lies in the development of training material for junior engineers and in the formulation of junior groups. While it is conceded that the immediate focus of interest of the junior engineer is his job, the Council feels that very serious consideration must be given to the long-range task of developing professional engineers in the broadest sense of the term. The assistance on problems of the job is definitely a responsibility of the local sections of the national societies. A tangible measure of assistance can be given by the local groups of engineers in acquainting the juniors with the provisions of the licensing law of their particular state and in organizing means of preparing qualified individuals to pass examinations or otherwise to meet the legal requirements."

Midwest Power Conference Offers 3-Day Program

A "MIDWEST Power Conference" will be held at the LaSalle Hotel in Chicago April 13 to 15, under the sponsorship of Armour Institute of Technology, with the cooperation of several midwestern state engineering schools and of various engineering societies.

The program will feature power plant engineering, including fuels, hydro power, electric power equipment, locomotive diesel units, metals, operating problems, and various economic and social considerations.

Inspection trips will be made to the Armour Institute of Technology Laboratories and to the Chicago plant of the Carnegie-Illinois Steel Company. There will be several luncheon and dinner programs, and entertainment for ladies.

(News continued on page 184)

WIRED HELP...THE *CHEAPEST* HIRED HELP

Fitting them to the world's work is a man-size job

An electric motor is an amazingly simple device. Any bright boy can follow instructions and make one that will run.

Yet the electric motor is the most important single factor in modern industry — and it is fast becoming equally important in agriculture. Equipped with automatic control, it frees time for other productive farm work.

But though motors themselves are simple and easy to use, the job of fitting them to their work is an exacting one. Every task, to be done efficiently, requires a certain type of motor. With many types, sizes and ratings available, the problem of fitting electric power to agriculture's varied requirements is one that Westinghouse is particularly well equipped to solve, to the end that farm work may be done better, faster, at lower cost.

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THE NAME THAT MEANS EVERYTHING IN ELECTRICITY

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directions for making motor model

Simple diagrams and instructions for making a motor, using materials on hand or readily obtainable. Ideal for demonstrating principles of motor design and construction to 4-H Club groups and vocational agricultural students. Write today for copies; also for other Westinghouse rural electrification helps.

SWITCH ON LOW COST POWER — 16 page booklet describing farm motor types and applications.

WIRED HELP — Booklet showing typical wiring diagrams and uses for electrical equipment.

COST-O-GRAPH — Wheel-type chart showing typical operating costs.

FARM HELP FROM THE HIGH LINE — Descriptive catalog of electrical helps for farm and home.

Address Rural Electrification Department, Westinghouse Electric & Manufacturing Company, 306 Fourth Ave., Pittsburgh, Pa.

Fire Prevention Booklet Reprinted

"Farm Fire Prevention and Control," a report of the ASAE Committee on Fire Prevention and Protection, has been reprinted as revised in 1936. It is a pocket-size booklet measuring 4x9½ inches and containing 27 pages of discussion and recommendations of the Committee. The single copy price is 10 cents. Special rates are available on quantity orders. (Any ASAE member may obtain one copy of this report, without charge, on request to the Secretary.)

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the March issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

H. E. Berger, project superintendent, Bureau of Agricultural Engineering, U. S. Department of Agriculture. (Mail) Oakville, Iowa.

E. L. Cooper, junior agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) SCS-Mo-26, Moberly, Mo.

James W. Crofoot, in charge of quality control, Cooperative G.L.F. Farm Supplies, Inc., Ithaca, N. Y.

Albert S. Curry, research in irrigation, New Mexico Agricultural Experiment Station, State College, New Mexico.

Raymond H. Ellis, assistant project engineer, Land Utilization Division, Hyde Block, Pierre, S. Dak.

Guy Ervin, assistant editor, Bureau of Agricultural Engineering, U. S. Department of Agriculture. (Mail) Box 84, Falls Church, Va.

B. L. Hagglund, district representative, Caterpillar Tractor Co., San Leandro, Calif.

Ira E. Hamblin, assistant agricultural engineer, Mississippi Agricultural Experiment Station, State College, Miss.

E. N. Humphrey, assistant agricultural engineer, University of Idaho, Moscow, Idaho.

Karl O. Kohler, Jr., regional engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) S2911 Manito Blvd., Spokane, Wash.

Donald E. Kuska, junior instrumentman, Central Nebraska Public Power and Irrigation District, Holdrege, Nebr. (Mail) 116 4th Ave.

Joe W. Little, superintendent CCC camp, Soil Conservation Service, U. S. Department of Agriculture, Paducah, Ky.

Manley L. Maddex, engineering aide, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Camp SCS-Va-14, Danville, Va.

Roy M. Magnuson, chief engineer, John Bean Division, Food Machinery Corp., San Jose, Calif. (Mail) Box 760.

Jack G. Moses, senior foreman, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Camp SCS-Va-9, Lynchburg, Va.

R. C. Nelson, regional engineer, Soil Conservation Service, U. S. Department of Agriculture, Amarillo, Tex.

J. M. Pearce, rural service engineer, Northern Indiana Power Company, Kokomo, Indiana.

A. H. Stephenson, engineering aide, Soil Conservation Service, U. S. Department of Agriculture. (Mail) SCS-Va-9, Lynchburg, Va.

C. M. Stokes, graduate assistant, agricultural engineering department, Alabama Polytechnic Institute, Auburn, Alabama.

G. C. Vaughan, engineering department, J. I. Case Co., Racine, Wis.

Fred Venrick, farm fieldman for Arkansas, Portland Cement Association. (Mail) 1023 Scott St., Little Rock, Ark.

Thomas A. Ventress, assistant county agent, Talladega, Ala.

TRANSFER OF GRADE

Dwight L. Chapman, project engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) 19 North 6th Street, Temple, Tex. (Transfer from Associate Member.)

Lee M. Cleland, camp superintendent, Soil Conservation Service, U. S. Department of Agriculture. (Mail) 244 South 3rd Street, Coshocton, Ohio. (Transfer from Associate Member.)

A. W. Clyde, associate professor, agricultural engineering department, Pennsylvania State College, State College, Pa. (Transfer from Member to Fellow.)

Alfred D. Edgar, associate agricultural engineer, division of structures, Bureau of Agricultural Engineering, U. S. Department of Agriculture. (Mail) Box 185, Cadillac, Mich. (Transfer from Member to Fellow.)

George W. Grisdale, Jr., junior agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) 444 East Second St., Moorestown, N. J. (Transfer from Junior Member to Member.)

E. R. Gross, professor of agricultural engineering (head of department), Rutgers University, New Brunswick, N. J. (Mail) Agricultural Experiment Station. (Transfer from Member to Fellow.)

N. D. Herrick, sales engineer, Edison Electric Illuminating Co., 39 Roylston St., Boston, Mass. (Transfer from Associate Member.)

G. I. Johnson, extension agricultural engineer, University of Georgia, Athens, Ga. (Transfer from Junior to Member.)

F. C. Lewis, associate professor in charge of farm structures, Purdue University, West Lafayette, Ind. (Mail) 475 Maple St. (Transfer from Associate Member.)

E. G. McKibben, associate professor of agricultural engineering, Iowa State College, Ames, Iowa. (Transfer from Member to Fellow.)

Howard T. Palmer, junior agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Boonsboro, Md. (Transfer from Junior Member to Member.)

George W. Pickering, manager agricultural sales, The Cleveland Tractor Co. (Mail) 1165 Pomona Road, Cleveland Heights, Ohio. (Transfer from Associate Member.)

Lawrence C. Porter, illuminating engineer, General Electric Co., Nela Park, Cleveland, Ohio. (Transfer from Member to Fellow.)

Peter A. Rasmussen, agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Stigler, Okla. (Transfer from Junior Member to Member.)

H. B. Roe, professor in charge of land reclamation activities, University of Minnesota, St. Paul, Minn. (Mail) Division of Agricultural Engineering, University Farm. (Transfer from Member to Fellow.)

Joseph W. Simons, junior agricultural engineer, Bureau of Agricultural Engineering, U. S. Department of Agriculture. (Mail) Barrow Hall, University of Georgia, Athens, Ga. (Transfer from Junior Member to Member.)

David C. Sprague, instructor, agricultural engineering department, The Pennsylvania State College, State College, Pa. (Transfer from Junior Member to Member.)

Dale E. Springer, associate engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Bethany, Mo. (Transfer from Junior Member to Member.)

E. T. Swink, assistant agricultural engineer, Virginia Polytechnic Institute, Blacksburg, Va. (Mail) Box 99. (Transfer from Junior Member to Member.)

Raymond J. Tillotson, junior agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Lamoni, Iowa. (Transfer from Junior Member to Member.)

Student Branch News

GEORGIA

GEORGIA'S Student Branch of the American Society of Agricultural Engineers held its regular meeting Monday evening, February 28. The meeting was called to order by the president, L. L. Reaves. During the regular business session the social committee completed plans for a dance, which was held Saturday evening, March 5.

The program for the evening was a debate on the following subject: "Resolved that the indicated field of agricultural engineering affords the best opportunities for the Georgia agricultural engineer, namely, farm structures, farm power and machinery, rural electrification, and soil and water conservation. It was a four-sided debate in which two students represented each field and tried to prove that their field afforded the most opportunities for the future agricultural engineer. This program proved to be one of the most interesting of the current quarter. The farm power and machinery field won first place, with the soil and water conservation field a very close second.

Due to examinations, the first meeting in March was moved up to March 7, at which time the General Electric Company, represented by C. C. Heath, showed a sound picture entitled "Bob Howard, R. F. D." This picture brought out the many advantages electricity offers the farmer, and gave an exceptionally good illustration of the uses and advantages of electricity to the rural home and community. The major roll which electricity assumes in the farm power field was also stressed.

Officers elected for the spring quarter were V. B. Garrard, president; S. A. Dance, vice-president; R. R. Garrard, secretary, J. S. Hawks, scribe.

Under the leadership of our president, L. L. Reaves, the Branch has enjoyed a successful quarter and we have been fortunate in having some interesting and educational programs. We are sure that the incoming officers will carry on this good work during the spring quarter.—*H. S. Glenn, Scribe.*

Agricultural Engineering Digest

A review of current literature by R. W. TRULLINGER, principal agricultural engineer, Office of Experiment Stations, U. S. Department of Agriculture.

SOIL EROSION AND STREAM FLOW ON RANGE AND FOREST LANDS OF THE UPPER RIO GRANDE WATERSHED IN RELATION TO LAND RESOURCES AND HUMAN WELFARE, *C. K. Cooperrider and B. A. Hendricks*. U. S. Dept. Agr., Tech. Bul. 567 (1937), pp. 88, pls. 20, figs. 15. The results herein reported were secured from the studies being conducted at the Southwestern Forest and Range Experiment Station, which is maintained in cooperation with the University of Arizona.

A general survey was made of the range and forest lands within the upper Rio Grande watershed to determine the facts regarding the relation of soil erosion and vegetation. The survey included an examination of the erosion conditions in Mesilla Valley, particularly the bordering range lands, below Elephant Butte Dam.

The lands of the Rio Grande watershed which embraces an area of at least 18,000,000 acres were originally covered with vegetation varying from semidesert savannas of the lowest plains to coniferous forests of the high mountainous districts. Recent intensive use of the land resources of the watershed have resulted in accelerated runoff and soil erosion, destructive floods, and land deterioration.

The striking evidences of these effects include deeply and continuously channeled alluvial valleys, deep arroyos, and wide sand washes where formerly there were only shallow surface runs, gullied slopes, increasing areas of badlands, and altered courses of mountain streams. Other definite manifestations are accumulations of loose stones and sand on the ground surface, soil humps capped by vegetation and remnants of topsoil, shifting sand and sand dunes, and disappearance of luxuriant valley grasses and soils, particularly of the topsoil.

Accelerated runoff and erosion have destroyed numerous primitive irrigation works, are causing the silting up of river channels and water reservoirs, and are resulting in the waterlogging and destruction of productive farm lands. Damaging floods have apparently increased during recent years, and recreational and wildlife resources are menaced by destruction through soil erosion.

The theories that climatic and geological changes have caused accelerated runoff and erosion do not seem tenable. Historical evidence clearly shows that the recent general decline of the watershed lands and resources began during the 1880's, following the impairment of the natural vegetation cover, principally through overgrazing and also from wanton timber cutting, man-caused fires, promiscuous wagon trailing, and injudicious dry farming.

The destructive floodwaters, laden with damaging silt, originate on over-grazed and damaged range and forest lands. The more the vegetation is injured the greater the degree of accelerated soil erosion. The lands of the watershed were grouped for convenience according to degree of soil erosion—normal erosion and moderate, advanced, and excessive accelerated erosion.

On only about 25 per cent of the lands of the drainage is there sufficient plant cover to control surface-soil erosion within normal and moderate limits, on about 35 per cent accelerated soil erosion is in an advanced stage, and on 40 per cent rapid land destruction is in progress.

The production of forage has been reduced fully 50 per cent, principally as a result of overgrazing and accelerated soil erosion. Such a decline in range resources has not taken place without adversely affecting the range industry and all other businesses of this area.

The preservation of the land resources in this watershed depends on a protective cover of vegetation. Accordingly, restoration of vegetation is needed not only on the lands that are badly denuded, eroded, and practically useless, but also on all other deteriorated lands of this area.

Representative areas on which the vegetation has come back sufficiently to check accelerated soil erosion show that, through protective management, as from overgrazing, impaired vegetation cover on lands not too badly eroded will tend to renew its former protective state. The results also show that the rate of recovery will be determined largely by the quantity of topsoil left and by the precipitation water that soaks into the ground and becomes available for plants during critical periods.

Principally because of greater annual precipitation and lower mean annual temperature, protective vegetation regenerates more rapidly on lands of the high mountainous districts than on low semiarid lands. Badly eroded spots within an area where vegetation responds quickly to protective management are soon defected by the influence of the recovering vegetation, and for this reason they heal within a comparatively short time.

Revegetation of seriously damaged lands may be aided through the use of supplementary artificial works which serve, among other ways, in checking runoff, in preventing land break-down in drainageways, and in effecting deposition of silt in which plants may establish themselves.

Supplementary works, such as levees and silt-detention dams for protecting farm lands and other properties in the main valleys, are necessary to counteract the damaging effects of accelerated runoff and erosion which result when the protective vegetation of a watershed declines; but they should never be considered an adequate substitute for the vegetation that had heretofore prevented accelerated erosion. The development and maintenance of a protective ground cover will extend the term of usefulness of such works.

USE OF SOIL-MOISTURE AND FRUIT-GROWTH RECORDS FOR CHECKING IRRIGATION PRACTICES IN CITRUS ORCHARDS, *C. A. Taylor and J. R. Furr*. U. S. Dept. Agr. Circ. 426 (1937), pp. 24, figs. 14. Designed to serve as a guide to citrus growers who need a more accurate control of soil moisture, this paper presents information on soil-moisture control; amount of moisture readily available to trees, typical orchard records, the use of fruit-growth and soil-moisture records, and procedure and equipment. It is pointed out that soil samples taken in the zones of soil most thoroughly permeated by feeder roots give the first indication of moisture exhaustion. Details are presented on the method of checking soil moisture in each furrow or border to determine penetration while the water is actually flowing. Fruit measurements before and after irrigation were found to indicate any unusual need of water in the tree and enable the grower to determine the satisfactory interval between irrigations.

TESTS WITH BAIT AND LIGHT TO TRAP CODLING MOTH, *H. N. Worthley and J. E. Nicholas*. Jour. Econ. Ent. 30 (1937), No. 3, pp. 417-422. Tests commenced by the Pennsylvania Experiment Station in 1934 with a view to developing a trap equally as effective as, but less expensive than, that described by Parrott and Collins are reported upon. The tests conducted in 1934 and 1935 have shown that the effectiveness of bait traps may be greatly increased by suspending them underneath 75-watt lights.

"Results obtained in three seasons appear to show that a trap costing $1.50 to make, and consisting of a light and reflector suspended above molasses-water bait in a pan 12 in in diameter, is more effective in killing codling moth adults than an electrocuting light trap that sells for about $15. . . . Employed in commercial orchards to reduce codling moth populations, the combination bait and light trap would be somewhat more expensive to operate than the electrocuting trap. The latter is automatic, while the former must be cleaned frequently and recharged with bait about every 10 days. However, the cost of bait and labor would scarcely equal interest on the extra investment in the electrocuting traps. Preliminary tests with the trapping light globes are encouraging, and means of increasing their effectiveness should be sought. The use of Anethol as an attrahent with bait in 1934 increased the catch of female moths more than five times."

EVAPORATION STUDIES.—I, A SURVEY OF EVAPORATION AND LIGHT VALUES IN GREENHOUSES, *J. D. Wilson*. Ohio Sta. Bimo. Bul. 186 (1937), pp. 87-97, figs. 3. For the purpose of making a general survey of existing climatic conditions, atmometer readings were taken over a 12-mo period in 31 widely distributed greenhouses varying greatly in construction, crops grown, etc. Evaporation was found greatest in July and at a low point in October, November, and December. Light values were low in December and January. Shading in summer reduced evaporation from the black atmometers by 22 per cent and the intensity of light by 38 per cent. Forcing heated air through the greenhouse increased evaporation approximately 50 per cent above that of houses warmed in the ordinary manner. (Continued on page 190)

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EFFECTS OF CARBON ARC LIGHT ON THE CHEMICAL COMPOSITION AND VEGETATIVE PROPAGATION OF TOMATO PLANTS GROWN WITH A LIMITED SUPPLY OF NITROGEN, *J. W. Mitchell.* Plant Physiol., 11 (1936), No. 4, pp. 833-841, figs. 3. "The total carbohydrate content of the above-ground portion of tomato plants increased approximately 400 per cent during a 10-day period in which the plants were grown with a nitrogen-free nutrient and exposed 12 hr daily to light from a carbon arc lamp. In plants given a limited supply of nitrogen and illuminated with artificial light daily, sucrose, starch, and dextrin, and polysaccharides concerned in the thickening of cell walls accumulated rapidly at first, then more slowly after several days of illumination, while the percentage of reducing sugars changed very little during the experiment. This decrease in the rate at which carbohydrates accumulated in the plants was accompanied by yellowing and abscission of the older leaves, thus decreasing the total leaf area per plant. This reduction in photosynthetic tissues may have been in part responsible for the decreased rate of carbohydrate accumulation during the latter part of the period in which the plants were grown in artificial light. There was an increase in the production and growth of roots by cuttings made from tomato plants grown in natural light of low intensity after the plants were exposed to arc light prior to making the cuttings. Cuttings made from such irradiated plants were less subject to decay than those taken from plants grown in natural daylight of low intensity during winter."

HOME CONVENIENCES ON TENNESSEE FARMS WITH REGIONAL COMPARISONS, *C. E. Allred and W. E. Hendrix.* Tennessee Sta. Agr. Econ. and Rural Social, Dept. Monog. 30 (1937), pp. [1]+III+41, figs. 21. In the nine representative Tennessee counties studied, 96.6 per cent of all farm dwellings are heated by fireplaces and stoves. Electric lights are used in 5.5 per cent. Wells furnish water for 53 per cent, springs and cisterns each for about one-fourth, and streams for 1.3 per cent, with 10 per cent of the farms having running water piped into dwellings, and 99 per cent carrying water for an average distance of 209 ft. Either improved outdoor toilets or indoor chemical or flush toilets are used in 17.8 per cent of the farm homes, 52.8 per cent use unimproved outdoor privies, and 29.4 per cent lack toilet facilities. Bathtubs are found in 2.7 per cent of all farm dwellings, showers in 0.9 per cent, and lavatories in 2.1 per cent. Of dwellings occupied by white owners, 10 per cent have kitchen sinks with drains, compared with 2.4 per cent for white tenants, 0.6 per cent for Negro owners, and 0.3 per cent for Negro tenants. More than one in five (21 per cent) farm families have refrigerators in their homes, and the proportion in Obion County is 60 per cent. Few farm families have improved laundry facilities. Wood or coal stoves are used in 93.6 per cent of all farm homes for cooking. Eighteen per cent of the farm families in the state had telephones in 1930 and 4.8 per cent had radios. Lawns have been established by 64 per cent of the farm families surveyed, and plantings of shrubbery have been made by 56 per cent.

Census data on electric lights, running water in dwellings, and radios show that the percentage of farm people in the state as a whole using these facilities has more than doubled since 1920. The percentage of farms reporting telephones, however, decreased from 22.5 per cent in 1920 to 18 per cent in 1930.

"A comparison of Tennessee with other states shows that Tennessee ranks high among southeastern states in modern improvements for the homes. In most items, however, other regions of the United States are above the southeastern states."

LIGHT IN RELATION TO THE EXPERIMENTAL MODIFICATION OF THE BREEDING SEASON OF TURKEYS, *H. M. Scott and L. F. Payne.* Poultry Sci., 16 (1937), No. 2, pp. 90-96, figs. 2. In a study at the Kansas Experiment Station, three lots of Narragansett female turkeys hatched in May were placed on experiment December 1. Lot 1 housed in an open-front poultry house received artificial lighting from 4:30 a.m. until daylight from December 1 to February 1 and in decreasing amounts until April 1; lot 2 was similiarly housed without artificial lighting, and lot 3 remained in the open throughout the winter and breeding season.

The artificial lighting modified the reproductive cycle of the turkey, lot 1 starting to lay in January whereas the other lots produced no eggs until early March. There was little difference in the response of lots 2 and 3, indicating that proper housing exerted no influence on the sex cycle of the turkey. Subsequent trials showed that exposure to either white light or the longer wave lengths of red light stimulated early sexual activity, while the shorter wave lengths of blue light failed to exert such effect. The early ovarian activity is attributed to the increased light ration rather than to the lengthening of the feeding day. Four hours' artificial lighting during the normal period of daylight were without effect. *(Continued on page 192)*

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EFFECTS OF LIGHT TRAPS ON A CODLING MOTH INFESTATION: A CONSIDERATION OF FOUR YEARS' DATA, *D. L. Collins and W. Machado.* Jour. Econ. Ent., 30 (1937), No. 3, pp. 422-427, figs. 3. The data on codling moth injury and population in an apple orchard equipped with light traps, based upon work by the New York State Experiment Station, Cornell University, and USDA Bureau of Entomology and Plant Quarantine cooperating over a period of 4 consecutive years, are here assembled and compared. The charts and data presented indicate "that the light traps exerted an influence on the codling moth infestation sufficient to be reflected in a measurable decrease in injury to the fruit. An evaluation of this influence on the basis of the different methods of comparison used leads to the inference that, under the given experimental conditions, the control achieved by light traps was comparable to that secured by the application of two cover sprays of lead arsenate."

SOME FACTORS IN TOMATO FRUIT SETTING, INCLUDING EXPERIMENTS WITH ARTIFICIAL LIGHT, *F. S. Howlett.* Ohio Veg. Growers Assoc. Proc., 21 (1936), pp. 79-86. Discussing the physiology of flower formation and pollination in tomato, the author reports the successful use of supplemental light in the greenhouses of the Ohio Experiment Station for increasing the number of flowers to attain full bloom and the set of fruit during the dark days of midwinter.

Literature Received

"HEATING, VENTILATING, AIR CONDITIONING GUIDE 1938" is the 16th edition of the official reference book compiled by the American Society of Heating and Ventilating Engineers. It is published for engineers, architects, contractors, schools and colleges, purchasing agents, manufacturers, public utilities, and others engaged in the field of heating, ventilating, and air conditioning.

The 1938 edition contains 840 pages of technical reference data, included in 45 chapters covering material on design and specifications of heating, ventilating, and air conditioning systems. Important new material which has been added on the cooling phases of air conditioning practice, includes extensive revisions of chapters on "Refrigerants and Air Drying Agents," "Cooling Load Determinations," and design of "Central Systems for Cooling and Dehumidifying." Noteworthy is the fact that a chapter on "Air Conditioning in the Treatment of Disease" appears for the first time. A new feature is a visual chapter index.

In addition to the technical material, over 300 pages of manufacturers catalog data are included, as well as an index to modern equipment listing 300 items, crossed-indexed as to product and manufacturer. A complete listing of society members, including their professional or business connections, forms a separate section.

Single copies of the "Guide, 1938" are available at $5.00 from the Society, 51 Madison Ave., New York.

"HOW TO LAY STEEL ROOFING," is a 94-page, 8½x11 in. paper-bound booklet in text form and generously illustrated published by the Agricultural Extension Bureau of the Republic Steel Corporation, Chicago, Ill. It includes chapters on "General Information on Steel Roofing," "Triple Drain Channel Roofing," "Corrugated Roofing," "V-Crimp Roofing," "Pressed Standing Seam Roofing," "Self Capping Roll Roofing," "Galvanized Steel Flashing," "Roof Drainage," and "Barn Ventilators."

"EXPLOSIVES FOR FIELD CLEARING" is a 6x9-in. 36 page illustrated bulletin published by E. I. du Pont de Nemours and Co., Wilmington, Del., describing practical methods of blasting stumps and boulders. Copies may be obtained from the publisher's agricultural extension section.

EMPLOYMENT BULLETIN

The American Society of Agricultural Engineers conducts an employment service especially for the benefit of its members. Only Society members in good standing may insert notices under "Positions Wanted," or apply for positions under "Positions Open." Both non-members and members seeking to fill positions, for which ASAE members are qualified, are privileged to insert notices under "Positions Open," and to be referred to members listed under "Positions Wanted." Any notice in this bulletin will be inserted once and will thereafter be discontinued, unless additional insertions are requested. There is no charge for notices published in this bulletin. Requests for insertions should be addressed to ASAE, St. Joseph, Michigan.

POSITIONS WANTED

MECHANICAL ENGINEER, with eighteen years' experience supervising engineering work on heavy farm machinery, is available for a position of a similar nature. PW-288